Irrigation Development Support Project (IDSP)
Ministry of Agriculture
Government of the Republic of Zambia

Environmental and Social Management Plan

Irrigation Development Support Project (IDSP) Remedial Works

Remedial Works on Makaba Dam

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Prepared by UNOPS for the Government of the Republic of Zambia

Names of Authors

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AF	Additional Financing
BDA	Biodiversity Assessment
BMP	Biodiversity Management Plan
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangerd Species of Wild Fauna and Flora
CoC	Code of Conduct
COD	Chemical Oxygen Demand
COVID-19	Corona Virus Disease 2019
CpUE	Catch per Unit Effort
CR	Critically endangered status
DMC	Dam Management Committee
DWRD	Department of Water Resources Development, previously Department of Water Affairs, WRDP implementer
E&S	Environmental and Social
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EPB	Environmental Project Brief
EPP	Emergency Preparedness Plan
ESA	Environmental and Social Audit
ESMP	Environmental and Social Management Plan
ESSAT	Environmental and Social Standards Advisory Team
EPBs	Environmental Project Briefs
FAO	Food and Agriculture Organization of the United Nations
FD	Department of Forestry
fsl	Full Surface Level
GBV	Gender Based Violence
GRM	Grievance Redress Mechanism
GRZ	Government of the Republic of Zambia
HSSE	Health Safety Social and Environmental
IBAT	Integrated Biodiversity Assessment Tool
ICOLD	International Commission on Large Dams
IDA	International Development Agency
IDSP	Irrigation Development Support Project
IDSP AF	Irrigation Development Support Project Additional Financing
ILO	International Labor Organization
ISDS	Integrated Safeguard Data Sheet (World Bank)
IUCN	International Union for Conservation of Nature

IV	Important Values
LC	Least Concern Status
KBA	Key Biodiversity Area
Kha	Thousand hectare
LMP	Labor Management Plan
MAR	mean annual runoff
MWDSEP	Ministry of Water Development Sanitation and Environmental Protection
msl	mean sea level
Mt	Million tonne
NGO	Non-governmental Organization
ODI	Overseas Development Institute
OP	Operational Policy (World Bank)
OPCS	Operational Policy and Country Services (World Bank)
PAD	Project Appraisal Document (World Bank)
PAP	Project Affected Person
PDO	Project Development Objective
PGA	Peak Ground Acceleration
PIU	Project Implementing Unit
RD	Relative Density
RBA	Relative Basal Area
RF	Relative Frequency
SEF	Safety Evaluation Flood
SEA	Sexual Exploitation and Abuse
SEP	Stakeholder Engagement Plan
TEVETA	Technical Education, Vocational and Entrepreneurship Training Authority
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UNOPS	United Nations Office for Project Services
USD	United States Dollar
VIP	Ventilated Improved Pit
VSU	Victim Support Unit
VU	Vulnerable Status
WARMA	Water Resources Management Authority
WRDP	Water Resources Development Project
YWCA	Young Women Christian Associates
ZABS	Zambia Bureau of Standards
ZEMA	Zambia Environmental Management Agency
ZMD	Zambia Meteorological Department

Executive Summary

Makaba Dam is located in Namwala District in the Southern Province of Zambia. It is one of ten dams that have been selected for remedial works under the World Bank-funded Irrigation Development Support Project (IDSP), which is implemented by the Ministry of Agriculture. Makaba Dam is an old earth fill dam, which was constructed in 2000 by the Ministry of Agriculture, and which was rehabilitated in 2008. It was built for fishing, irrigation and livestock watering and thus has an outlet. In 2017 the World Bank-funded Zambia Water Resources Development Project (WRDP) undertook further construction works on the dam, which included the repairing the spillway and drop structures. The WRDP was classified as a 'Category B' project under the World Bank safeguards policies, and several operational policies (OPs) in relation to the dam construction were triggered. However, the World Bank's mid-term review of the WRDP identified non-compliance issues with safeguards policies and poor quality of construction works at the dam. Despite efforts to bring the project back on track, the project continued to remain out of safeguards compliance and the WRDP was closed in 2018.

The World Bank has provided Additional Financing (AF) to the IDSP, to support remedial works on 10 of the dams constructed or rehabilitated by the WRDP. This includes Makaba Dam. The United Nations Office for Project Services (UNOPS) is tasked with overseeing works and with the preparation of this Environmental and Social Management Plan (ESMP) and a Biodiversity Management Plan (BMP), on behalf of the Government of the Republic of Zambia. The BMP was prepared as a separate report and annexed to this ESMP, following a biodiversity assessment of the dam's area of influence. The objectives of the ESMP and BMP are to guide the remedial works on the dam, mitigate imminent identified risks to the environment, safety of communities and their associated livelihoods, and to bring the dam in compliance with World Bank safeguards policies.

UNOPS has developed detailed designs for the remedial works on Makaba Dam. The works will not change the nature and scope of the existing dam operation activities. They will be implemented in two ways: a) construction and demobilization, and b) remediation of the existing site.

Institutional Arrangements: The sub-project works on Makaba Dam will be managed and implemented by the Ministry of Agriculture of Zambia, under the IDSP. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the IDSP-PIU will manage and implement the broader Additional Financing (AF) activities, it has contracted UNOPS to oversee and implement the remediation works on the ten selected dams, including the Makaba Dam. UNOPS will procure and oversee a contractor for the remedial works on the dam.

The dam community is expected to own this sub-project and report any grievance or misconduct by the contractor or its personnel to the IDSP-PIU through the AF Project Grievance Redress Mechanism (GRM). Upon completion of the works, the management, operation and maintenance of the dam will therefore be handed over to the Makaba DMC. In order to successfully operate the dam, and limit its negative impacts on people and environment, the DMC members and the communities will receive capacity building and training.

The ESMP addresses the environmental and social risks and impacts, which were identified through extensive field assessments. It includes a construction works management plan with mitigation measures and performance indicators for non-hazardous waste; hazardous waste; soil; land use and aesthetics; surface and groundwater pollution; air quality and noise; sanitation; traffic; biodiversity assessment and

BMP; community health and safety; gender equality, Gender Based Violence (GBV) and Sexual Exploitation and Abuse (SEA); labor and working conditions; decommissioning and rehabilitation measures; and maintenance and monitoring.

It further includes a separate rehabilitation and remediation plan to identify, rehabilitate and remediate environmental and safety issues caused by the past construction works, as well as to enable completion of existing incomplete dam construction, and to outline the requirements to return disturbed sites to a state that is similar to that prior to construction.

The key structural legacy issues of Makaba Dam include possible overtopping of the embankment; seepage and embankment failure; and failure of the dam embankment due to headward erosion and undermining of the spillway. There has been progressive damage to the spillway return drop structures, return channel and training walls from passing successive floods as well as damage to the main embankment from both livestock and runoff – particularly at the downstream face. Evidence of several "boils" in the seepage areas immediately downstream of the toe is further cause for concern.

Health and safety and non-structural risks related to legacy issues of the dam include unrehabilitated contractor sites that pose health and safety issues for the community; the inability to monitor and assess downstream ecological effects of the dam operation; stagnant water ponds within the spillway that can be vector breeding areas and may cause drowning risks; lack of access across the river; as well as several injury and drowning risks for community members related to lack of awareness.

Social concerns include limited irrigation activities and resulting risks of food insecurity due to the short canal; uncontrolled stock watering movements, which damage the embankment structure; and a lack of capacity / training for community members to benefit fully from irrigation water supply.

Lastly, the ESMP includes a capacity building and training plan that lays out the capacity building requirements and necessary training for DMC members and communities and other stakeholders in relation to the construction and operation phase of the planned works at Makaba Dam. Similarly, a stakeholder engagement plan contains the detailed modes of engagement with a variety of stakeholders in order to ensure appropriate dissemination of all information regarding the works; and to allow for consultation of stakeholders on dam-related environmental and social issues. A Grievance Redress Mechanism (GRM) has been designed for the AF to allow stakeholders to file any feedback or grievances and receive appropriate responses from the IDSP.

1 Introduction

Makaba Dam is located in Namwala District in the Southern Province of Zambia. It is one of ten dams that have been selected for remedial works under the World Bank funded Irrigation Development Support Project (IDSP). According to OP 4.37, the dam is classified as a small dam because its height is less than 15m. The current structural integrity of Makaba Dam has been heavily compromised, which poses threats to the safety of the local community and downstream users. UNOPS has been tasked to prepare this Environmental and Social Management Plan (ESMP) on behalf of the Government of the Republic of Zambia. The ESMP guides the remedial works on the dam, mitigates imminent identified risks to the environment and the safety of communities and their associated livelihoods, and brings the dam into compliance with World Bank safeguards policies.

UNOPS has conducted environmental, social and dam engineering studies based on desk reviews, interviews and consultations with key sub-project stakeholders, and collection of field data at the dam site using field-specific equipment. Initial field screening visits by the team revealed that an in-depth biodiversity assessment of the dam site was required. The biodiversity assessment was undertaken, the data analyzed and a BMP prepared and annexed to this ESMP

Dam rehabilitation works will commence after the approval and disclosure of this ESMP. The ESMP will be communicated to the stakeholders prior to the works. Dam rehabilitation works are anticipated to take 6 months.

1.1 Project Background and Description

Makaba Dam is an earth fill dam that was constructed in 2000 by the Ministry of Agriculture. It was rehabilitated in 2008. It was built for irrigation and livestock watering and thus has an outlet. In 2017 the World Bank-funded Zambia Water Resources Development Project (WRDP) (P114949) funded the repair of the spillway and drop structures.

The Water Resources Development Project (WRDP)

The WRDP became effective in 2013 and was closed in 2018. The PDO of the WRDP was 'to support the implementation of an integrated framework for development and management of water resources in Zambia'. The WRDP had three components: Component A: Water Resource Management; Component B: Water Resources Development; and Component C: Institutional Support. Component B included the support for the design, rehabilitation and construction of 100 small dams. Of these, only 12 dam sites were procured for construction or rehabilitation. Makaba Dam was one of them.

WRDP E&S Safeguards: The WRDP was classified as a 'Category B' project under the World Bank safeguards policies, and several policies were triggered. As a result, the following instruments were prepared, consulted and agreed upon: i) Environmental and Social Management Framework with provision for cultural resources management and protection; ii) Pest Management Plan; and iii) Resettlement Policy Framework. The World Bank Integrated Safeguard Data Sheet (ISDS) indicated that the project would not finance the construction of large dams and required only the generic dam safety measures contained in existing operational procedures and the application of the 2010 Food and Agricultural Organization (FAO) Technical Guide for Small Earth Dams for compliance with safeguards on Dam Safety.

The World Bank's mid-term review of the WRDP, however, identified non-compliance issues with safeguards policies and poor quality of construction of the Makaba and other dams. As a result, the Project Management Unit prepared Environmental Project Briefs (EPBs) for the dams, which were finalized between March and June 2016 and approved by Zambian Environmental Management Agency (ZEMA) between January and May 2017. However, these EPBs were not compliant with World Bank safeguards policies and despite efforts to rectify the issue, the non-compliance persisted. As a consequence, on March 26, 2018, the World Bank issued a Partial Suspension of the Project. The suspension limited project expenditure to addressing safeguards issues and remediating the dams that had already been built or rehabilitated under the WRDP. Although EPBs and an ESMP for 8 dams were in place, remedial works at the ten dam sites had not taken place at the time of project closure in 2018. Since the closure of the WRDP, the World Bank and GRZ have worked to address the outstanding issues, given the responsibilities and obligations of the parties set out in the WRDP's Financing Agreement. On October 10, 2019, the World Bank and the GRZ agreed on remedial actions to ensure the safety of the 10 dams that were constructed/ rehabilitated under the WRDP. To address the shortfalls, remedial works would be financed under the Irrigation Development Support Project (IDSP).

Irrigation Development Support Project (IDSP)

The Irrigation Development Support Project (IDSP) (P102459) was approved and became effective in 2011. Two restructurings of the original project changed the Project Development Objective (PDO), the number of components and the closing date. The current PDO of the IDSP is to 'provide improved access to irrigation services in selected sites in the Recipient's territory'. The project consists of three components:

- Component 1: Public infrastructure Investment;
- Component 2: Development of irrigation management capacity; and
- Component 3: Project management and coordination

As part of the 2019 agreement it was decided that the remedial work of these dams will be carried out through the IDSP, based on a two phased approach. The first phase is financed by the IDSP parent project, the second phase through Additional Financing (AF).

Phase 1 covers preparatory activities that will facilitate the works to remediate dam safety and integrity and to realise its original intent (which was to the benefit the local community and the department of agriculture). The scope of Phase 1 consists of a) undertaking the necessary investigations for remediation, including in regards to dam safety and environmental and social safeguards; b) prepare an ESMP and Biodiversity Management Plan; c) undertaking immediate, limited, structural and non-structural interventions to minimize immediate risks to communities caused by the dam.

IDSP Additional Financing (AF)

The AF extends the deadline of the IDSP to 30 November 2022. It consists of three distinct sets of activities: Activity 1: Completion of ongoing works under the IDSP and cost replenishment; Activity 2: Remedial works for the 10 WRDP dams; Activity 3: Drought emergency response. The remediation of Makaba Dam and the nine other dams will be implemented under activity 2.

Phase 2 of the 2019 agreement and activity 2 of the AF provide remedial activities to reduce the risks/impacts related to construction and operation of the Makaba Dam and provide support through training and capacity building, which is required to safely operate the dams and reduce the downstream environmental impacts. It is envisaged that the activities associated with the works will not change the

nature and scope of the existing scheme and will not increase the dam's existing capacities. With this, it is projected that the remedial measures will not adversely change the quality or quantity of water flows downstream to other areas.

The scope of Phase 2 for Makaba Dam consists of:

a) Civil works on the dam to ensure the safety of dam and downstream communities;
b) Establishment of operation and maintenance arrangements;
c) Continuation of surveillance;
d) Upon completion of the works, hand-over of the management, operation and maintenance of the dam to a DMC comprising people from the beneficiary communities;
e) Implementation of the Environmental and Social Management Plan (ESMP), including remediation of environmental legacy areas such as borrow pits; and
f) Training of communities on how to operate and conserve the catchment.

1.2 Objectives of the ESMP

This ESMP has been prepared to guide all the works on Makaba Dam during Phase 2 of the IDSP AF. The main objectives of this ESMP are to mitigate against imminent identified risks to the environment, safety of communities, and their associated livelihoods, and to bring the dam construction and management into compliance with World Bank safeguards policies.

1.3 Methodology

This ESMP is based on a desk review of available information and field data collection, which included consultations with members of the Makaba dam community, representatives of local government authorities, representatives of the GRZ, and members of the World Bank and IDSP teams. Field visits were conducted to the Makaba Dam site for detailed on site assessments of the environmental and social impacts of the sub-project and legacy sites. This ESMP has been guided by the Zambian Environmental Management Act EIA Regulations (1997), as well as by the World Bank's OPs. Reference is made to the initially prepared EPBs (DWRD 2017), the Remedial ESMP for 8 dams (COWI 2018), the Environmental and Social Audit (ESA) (April 2020), and recent dam assessments in order to determine environmental and social requirements for rehabilitation and restoration measures. The EMSP follows the format, which is laid out in the Environmental and Social Audit (April 2020).

In summary the following activities were undertaken by UNOPS:

- Literature review, including data and documentation provided by the IDSP to UNOPS:
    - Remedial Environmental and Social Management Plan of Eight (8) Dams Under the Water Resource Development Programme (2018)
    - Approval Decision letters by Zambia Environmental Management Authority (2017)
    - Environmental Project Briefs (EPB) prepared under WRDP (2017)
    - Environmental and Social Audit of 10 Dams (IDSP 2020)
- Field studies by the UNOPS environmental and social safeguards and engineering teams in July 2020, accompanied by IDSP team members.
    - Site environmental and social assessments.
    - Site and analytical geotechnical studies

    - Site surveying
    - Site and desk terrestrial and aquatic biodiversity studies
    - Site and desk hydrological studies

- Public participatory interviews focus group discussions and community consultations.
- Environmental quality monitoring – water quality sampling and analysis.
- Ad hoc filling in of matrix and checklists based on impact assessment.

The ESMP has included the preparation of the following plans and reports:

- Policy, legal and institutional framework
- Baseline conditions
- Remedial design with
    - Geotechnical information
    - Survey information
    - Hydrology information
- Safety reports-operations and maintenance/ emergency preparedness plan
- Basic biodiversity management plan (to be updated through a separate Biodiversity Assessment and Management Plan
- General construction works management plan
- Rehabilitation plan
- Training plan and stakeholder engagement
- Grievance redress mechanism
- ESMP implementation process

2 Policy, Legal and Institutional Framework

Environmental and social sustainability is vested in international and national policies, laws, regulations, guidelines and standards that guide the implementation of this sub-project. The below table outlines key legislation that regulates the environmental and social aspects during dam rehabilitation through to the operational phases. The sub-project activities must fully comply with the relevant legislation of the Republic of Zambia as well as with the World Bank safeguards policies.

2.1 National Policy and Legislative Framework

These policies and others are actively implemented through compliance with the legislative frameworks described below. Table 1 outlines the various laws of the Republic of Zambia that are relevant to the proposed works.

Table 1: Laws relevant to the sub-project

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
Environmental and Natural Resource Management			
Environmental Management Act No.12, 2011	To protect the environment and control pollution, so as to provide for the health and welfare of persons, animals, plants and the environment. This Act provides for the management of effluent discharge, air and noise pollution, the parameters which are relevant to this sub-project.	UNOPS to ensure the relevant regulations are mainstreamed in the ESMP and enforced. IDSP to monitor compliance throughout sub-project lifespan.	Activities to be undertaken as remedial measures to the dam's safety and integrity are likely to have environmental impacts. Provisions for mitigation measures for identified sub-project impacts are put in place in order to eliminate or reduce the effects of these impacts. The measures are consistent with the requirements in the Environmental Management Act of 2011. As an example, some of the works to be undertaken may result in environmental discharges that will require ZEMA licenses for compliance and monitoring. Relevant regulations have been included in this ESMP and contractor's compliance with the regulations during the rehabilitation of the dam will be ensured.
Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997	Under these regulations, a developer will not implement a project for which a project brief or an environmental impact statement is required, unless the project brief or an environmental impact assessment has been		At the national level, the Environmental Impact Assessment (EIA) regulation of 1997 gives guidance, schedules and categories for the various project types and the relevant EIA studies to be undertaken. It further gives provision on post- EIA approval management of projects and guidelines for developing ESMPs. This has been followed.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	concluded in accordance with these Regulations and the Council has issued a decision letter.		
Solid Waste Management Act of 2018	To ensure disposal of generated solid waste to designated sites	UNOPS to ensure the regulation is enforced through the ESMP IDSP to monitor compliance throughout the sub-project lifespan Local Municipal Authority	This ESMP takes into consideration solid waste management at work sites by introducing a parameter that will compel the contractor to take care of all the generated solid waste at their worksites and appropriately dispose of the same.
Natural Resources Conservation Act, Cap 315, 1970	To conserve and protect both natural and cultural heritage, e.g. waterfalls, in perpetuity and other resources within the boundaries of the site for the benefit of the present and future generations.	UNOPS to ensure enforcement during preparation and construction phase IDSP to monitor compliance throughout sub-project lifespan	The ESMP takes into consideration a biodiversity assessment BMP, detailing specific conservation and mitigation measures to ensure sub-project activities promote the conservation and protection of both natural and cultural heritage in the sub-project affected areas, in compliance with the regulation.
Fisheries Resources Management			
Fisheries Act, Cap 200, 1974	Provides for development of commercial fishing and the registration of fishermen and their boats and the protection of endangered fish species.	IDSP Monitoring: Ministry of Agriculture and Livestock	The proposed dam will be used for fishing among other uses; there are some small scale commercial fishing activities developed by communities. The provisions of this Act will be complied with in the management of these fish resources. Fishing will be conducted according to the regulations and the Department of Fisheries will be involved to educate the community in view of its activities.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
			UNOPS, on behalf of the GRZ, has included actions to ensure species are protected. The Department of Fisheries in the District will be involved.
Lands Management			
The Lands Act, 1995 (CAP 292, CAP 289, CAP 288)	The Department of Lands administers the Land Act, 1995 (CAP 292, CAP 289, CAP 288) and the Lands Acquisition Act, 1995 for the allocation and alienation of land under statutory leaseholds. The Department is also responsible for the administration of lands and deeds registration and land surveys and mapping.	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Lands, Natural Resources and Environment Protection	No additional land is expected to be required for this sub-project. If any land acquisition be required, UNOPS/ IDSP will comply with this regulation which governs the acquisition of the land to be used for various developmental activities.
Urban and Regional Planning Act, No. 3 of 2015	Provides for the appointment of planning authorities, the preparation approval and revocation of development plans, and the control of development and subdivision of land.	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Local Government and Housing Local Authorities	The land around the dam falls within traditional tenure. UNOPS, on behalf of the GRZ, will comply with this regulation for the approvals of construction and development plans within a locality if required.
Local Government Act, 1990	Provides for the establishment of Councils in districts, the functions of local authorities and the local government system.	Ministry of Local Government and Housing Local Authorities	The function of the municipalities is guided by the provision of the Local Government Act. UNOPS, on behalf of the GRZ, will comply with the requirements of this Act for measures related to pollution control and environmental protection functions, which are handled by the local council. It will ensure that the

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
			council and stakeholders are involved in the planning, rehabilitation and operation activities.
Agricultural Lands Act No 13 of 1994 (Cap. 187)	The Act establishes the Agricultural Land Board and provides for its functions which inter alia includes; keeping under review the use that is being made of state land, outside urban and peri-urban areas and to make recommendation to the Minister responsible for agriculture. The Act provides for tenant farming schemes.	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Agriculture	The sub-project construction work and dam operation activities may be carried out on agricultural lands and thus assessment of the impacts of these activities on the agricultural areas in the sub-project area was undertaken. UNOPS, the contractor and stakeholders will comply with this law in relation to rehabilitation and operation of the dam.
Traffic Management			
The Road Traffic Act No. 11 of 2002	Establishment of the Road Transport and Safety Agency (RTSA). It also provides for a system of road safety and traffic management in Zambia.	Contractor Monitoring: UNOPS	The transportation of construction materials has the potential to cause accidents, hence traffic control measures must be employed and the development must comply with provisions of the Act. UNOPS and contractors will comply with all the regulations under this Act, traffic safety rules for communities, and traffic management. This ESMP includes a traffic management plan.
Tourism Management			
Zambia Wildlife Act No. 14 of 2015	Management and Protection of National Parks and Wildlife respectively	UNOPS to ensure enforcement during preparation and construction phase Monitoring:	The dam is located in a remote rural area; hence all activities by UNOPS will comply with the requirements of this regulation on behalf of the GRZ if protection of wildlife is required. The ESMP determines appropriate action to ensure preservation of national parks and protected areas, wildlife, and protected and endangered species by including ecologists

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
		Ministry of Tourism	on the team. A biodiversity assessment was conducted and a separate BMP prepared.
Employment and Labor			
Workers' Compensation Act No. 10 of 1999 Employment Act	All employment regulations and laws.	Contractor UNOPS Monitoring: Ministry of Labour	UNOPS, on behalf of the GRZ, will ensure that the contractor complies with provisions of these regulations during the course of deployment.
Occupational Health and Safety Act	Provides for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery.	Contractor UNOPS Monitoring: Ministry of Labour	UNOPS, on behalf of the GRZ, will ensure that the contractor complies with the occupational health and safety requirements of the Act, promotes safety, and puts in place all measures required to ensure the well-being of workers.
Worker's Compensation Act No. 10 of 1999	Establishment and administration of a Fund for the compensation of workers disabled by accidents to, or diseases contracted by such workers in the course of their employment, and for the payment of compensation to dependants of workers who die as a result of such accidents or diseases.	Contractor UNOPS Monitoring: Ministry of Labour	This Act is relevant to the sub-project because workers are at higher risk of suffering from injuries that could lead to disabilities or contracting diseases due to the nature of their work environment. In the event of work-related accidents, the provisions of this Act will be triggered. UNOPS and its contractor will comply with regulations under this Act by registering with the Workers Compensation Board and being compliant providing safe working sites.
Community Health and Safety			
The Public Health Act of 1995	Prevention and suppression of diseases and regulation of all matters connected with	Contractor UNOPS	The sub-project is likely to cause pathogens due to human activities. Measures to prevent diseases and pollution

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	public health. This law may be read together with the Local Government Act, Cap 281 of the laws of Zambia. The Act empowers the Ministry of Health and the Councils to prevent diseases and pollution dangerous to human health, as well as prevention of pollution to any water supply for domestic use.	Monitoring: Ministry of Health	particularly during the rehabilitation and operation phases will be instituted. UNOPS, on behalf of the GRZ, will take measures to prevent diseases and pollution dangerous to human health by ensuring that there are good sanitation and waste disposal systems on the working premise, through the prevention of vectors etc. COVID-19 prevention and management measures are included in this ESMP.
The Gender Equity and Equality Act, 2015	Taking of measures and strategic decisions to ensure gender equity, equality and integration of both sexes in society; promotes gender equity and equality as a cross cutting issue in all spheres of life and stimulate productive resources and development opportunities for both sexes; prohibits harassment, victimization and harmful social, cultural and religious practices; provides for public awareness and training on issues of gender equity and equality; provides for the elimination of all forms of discrimination against	Contractor UNOPS Monitoring: Ministry of Gender Ministry of Community Development and Social services	Sub-project works and operation will require gender mainstreaming and prevention and mitigation measures for GBV UNOPS and its contractor will comply with all the regulations under this Act. This ESMP includes a gender equality and GBV Action Plan.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	women, empowers women and achieve gender equity and equality		
The Anti-gender-based Violence Act, 2011	The Act provides for the protection of victims of gender-based violence; constitutes the Anti-Gender-Based Violence Committee.	Contractor UNOPS Monitoring: Ministry of Gender Ministry of Community Development and Social services	Worker influx bears risks of GBV cases. UNOPS and its contractor will comply with all the regulations under this Act. Sensitisation, reporting and referral pathways will be put in place.
Disaster Management			
Disaster Management Act, 2010	Establishes and provides for the maintenance and operation of a system for the anticipation, preparedness, prevention, coordination, mitigation and management of disaster situations and establishes the Disaster Management and Mitigation Unit (DMMU).	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Office of the Vice President District Commissioner Office	Dam safety risk and emergency response measures need to comply with the Act and should involve the necessary stakeholders. UNOPS' engineering and safeguards teams will work together for remedial actions that promote safety. The UNOPS and IDSP will involve the DMMU in implementing safety and emergency measures.
Zambia Coronavirus Disease (COVID-19) Statutory Instruments Public Health (Infected Areas) (Coronavirus Disease 2019) Regulations, No.	Construction and operational activities will involve personnel and the community on site. Zambia is currently experiencing the COVID-19 pandemic according to the national notifiable infectious disease declaration notice of March 2020.	UNOPS to ensure enforcement during preparation and construction phase	COVID-19 prevention and management measures are included in this ESMP.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
22 of 2020; Public Health (Notifiable Infectious Disease) (Declaration) Notice, No. 21 of 2020; The Employment Code (Exemption) Regulations, 2020; The Public Health (Infected Areas) (Coronavirus Disease 2019) (Amendment) Regulations, 2020			

2.2 World Bank Operational Policies

This sub-project will comply with the World Bank OPs. In addition, it will be guided by the WBG Environmental, Health and Safety Guidelines (EHS Guidelines); the World Bank's Good Practice Notes on 'Addressing Gender Based Violence in Investment Project Financing Involving Major Civil Works'[1] and on 'Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx[2].

Table 2 describes the triggered policies and actions to be followed by the IDSP AF/UNOPS and the constructor. The ESA indicated 6 triggered policies for the project, but the Makaba Dam subproject has not triggered the OP 4.12 **(**Involuntary Resettlement), because there is no anticipated resettlement for the subproject.

Table 2: Relevant World Bank Operational Policies (OP)

OP	**Name**	**Actions to be followed by the IDSP AF / UNOPS**
OP 4.01	Environmental Assessment:	The project was classified EA Category B and an Environmental and Social Audit (ESA) was prepared to comply with OP 4.01. The policy is triggered because of the potential impacts the remediation works on Makaba Dam could have on the environment and people. Some of the potential impacts include: soil excavations, borrow pits, construction waste, clearing of vegetation, noise, sedimentation, and downstream flow restrictions, etc. For the remediation works at Makaba Dam, UNOPS has prepared this ESMP, following the requirements defined in the ESA. The sub-project will implement all measures described in both instruments to mitigate all identified negative impacts.
OP 4.04	Natural Habitats:	This policy is triggered because the construction of the dam has caused impacts on natural and modified habitats. Also, the impact of the operation of the dam on downstream flow and the induced impacts of increasing human populations on both aquatic and terrestrial ecosystems was identified in the ESA as an area of weakness in the previous safeguard instruments.

[1] World Bank, Good Practice Note. Addressing Gender Based Violence in Investment Project Financing involving Major Civil Works, September 2018

[2] World Bank, Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx, OPCS and ESSAT, December 2016.

		The previous ESMP prepared for 8 dams, including Makaba Dam, listed some of the ecological impacts associated with dam and flow regulation but argued in favor of Makaba Dam as a means of guaranteeing flow in the downstream system in the dry season and during times of drought. This presupposes that flows will be managed to benefit downstream ecology, which, given capacity limitations and cost, is far from certain; and while there may be benefit in supplementing ecological base flows in dry periods, this does not necessarily outweigh other negative considerations. Cumulative changes brought about by the dam may negatively affect the downstream aquatic and wetland environment, including creating a barrier to the movement of aquatic species. The opportunity to properly address these issues, as required by OP 4.01, has to some extent passed. The dam is already built. There are, however, some options for impact minimization, as well as actions to make the most of the potential benefits of flow regulation. It should be noted, however, that Makaba Dam was constructed on a seasonal stream and therefore the downstream ecology is likely to be cut off from the overflow via the spillway in dry season. The downstream and upstream ecology survives on the water dambos that remain existing in the river bed. This ESMP provides measures to mitigate negative impacts on terrestrial and aquatic ecosystems in the area of influence of the dam, which include impacts by the previous construction works (see remediation plan in this ESMP), as well as impacts that will be caused by the current construction teams in their day to day activities. UNOPS has further conducted a biodiversity assessment and prepared a BMP to enhance conservation of flora and fauna during and after the remedial works.
OP 4.09	Pest Management	The policy is triggered because of the potential impacts the activities of the IDSP to be supported with the AF could generate (in the use of agrochemicals) in agriculture expansion as result of the remediated dam all to serve water provision for agriculture -irrigation. The IDSP Pest Management plan will be adhered to.
OP 4.37	Safety of the dam	This policy is triggered because the remediation works at the dam are necessary to ensure dam safety. The dam is considered a small dam because it has a height less than 15m. UNOPS and its contractors will follow Good International Industry Practice (GIIP) to determine and implement corrective actions that mitigate dam safety issues. For the sub-project a *Plan for construction supervision and*

		quality assurance, *Operation and Maintenance (O&M) Plan*, and an *Emergency Preparedness Plan (EPP)* have been prepared.
OP 7.50	Project on International Waterways	The policy is triggered because the remediation of the dam site was not previously part of the IDSP umbrella, and Makaba Dam is located on a tributary of the Zambezi River. Under the AF, IDSP has requesting for an exception to notification according to paragraph 7a[3] of the policy. The project qualifies for an exception given that works and activities would not exceed the original scheme, change its nature, or alter or expand its scope and extent as to make it appear a new or different scheme. The dam remedial works consist of strengthening and stabilizing existing dam embankments and completing and reinforcing the existing spillway to ensure dam safety. The activities will not change the nature and scope of the existing schemes and will not increase the dam's existing capacity. Therefore, these remedial measures will not adversely change the quality or quantity of water flows to the other riparian users; and will not be adversely affected by the other riparian users' possible water use. Further, the sub-project also includes measures identified in this ESMP, which will help mitigate impacts on flows and water quality.

2.3 World Bank Group Environment Health and Safety Guidelines

The WBG EHS Guidelines contain the following guidelines included in the ESMP to be applied on the subproject:

- Environment- air emissions and quality; energy conservation; wastewater and ambient water quality; water conservation; hazardous materials management; waste management; noise and contaminated land.
- Occupational health and safety- facility design and operation; communication and training; hazards; PPE and monitoring.
- Community health and safety- water quality and availability; infrastructure structural safety; life and fire safety; traffic safety; transport of hazardous materials; disease prevention and emergency preparedness and safety.
- Construction with decommissioning –environment, occupational health and safety and community health and safety.

[3] The following exceptions are allowed to the Bank's requirement that the other riparian states be notified of the proposed project: (a) For any ongoing schemes, projects involving additions or alterations that require rehabilitation, construction, or other changes that in the judgment of the Bank (i) will not adversely change the quality or quantity of water flows to the other riparians; and (ii) will not be adversely affected by the other riparians' possible water use. This exception applies only to minor additions or alterations to the ongoing scheme; it does not cover works and activities that would exceed the original scheme, change its nature, or so alter or expand its scope and extent as to make it appear a new or different scheme. In case of doubt regarding the extent to which a project meets the criteria of this exception, the executive directors representing the riparians concerned are informed and given at least two months to reply. Even if projects meet the criteria of this exception, the Bank tries to secure compliance with the requirements of any agreement or arrangement between the riparians.

3 Institutional Arrangements for E&S Management of the Sub-Project

The Makaba Dam remedial works will be managed and implemented by the Ministry of Agriculture (MoA) of Zambia. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the PIU of the IDSP will manage and implement the broader AF activities, it has contracted UNOPS to oversee and implement the remediation works of the ten dams, including Makaba Dam. The IDSP-PIU Environmental & Social Team is responsible for all E&S aspects of the IDSP. It will supervise and monitor all E&S aspects of all activities implemented by the UNOPS Sub-PIU and UNOPS contractor at the Makaba dam site. The UNOPS Sub-PIU E&S Team is responsible for the implementation of the E&S mitigation measures laid out in this ESMP. Where implementation is conducted by contractors, the UNOPS Sub-PIU E&S Team supervises and monitors all E&S related aspects of the contractor's works. The institutional arrangements are summarized in Figure 1.

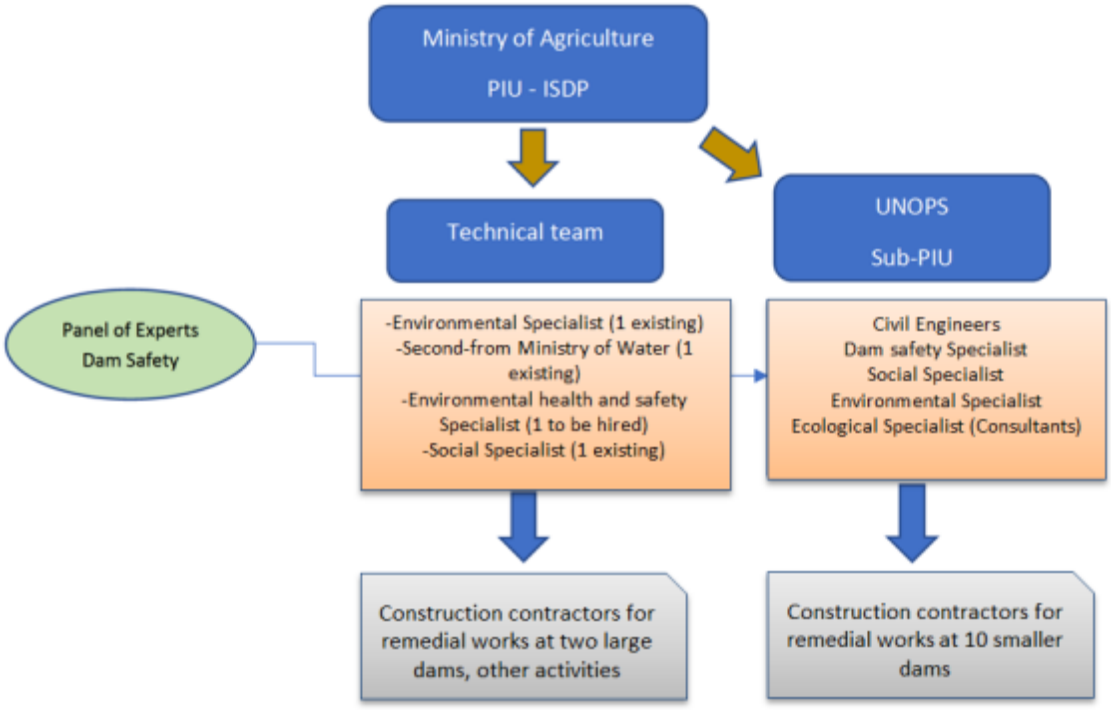


Figure 1: Institutional arrangement for sub-project implementation

3.1 Ministries / IDSP-PIU

The IDSP-PIU is situated within the Ministry of Agriculture and will have overall oversight of the dam remediation works and the implementation of this EMSP.

The IDSP-PIU will therefore include one environmental specialist, one environmental health and safety specialist, and one social specialist to support the overall supervision of the remedial works.

The IDSP-PIU will further provide support to the dam remediation activities through a dam safety panel of experts, which will have oversight over the works, remediation plans, safety plans, etc.

The IDSP-PIU will retain the primary responsibility for ensuring that environmental and social commitments for the Makaba Dam are met throughout the sub-project lifespan vis-à-vis the World Bank.

The IDSP-PIU will establish a schedule of supervision and monitoring for the environmental and social management of the Makaba dam site. Environmental and social issues are the responsibility of all personnel, from the management to the operator. However, day-to-day supervision and monitoring for the planning and implementation of the whole sub-project lies specifically with the environmental specialist, the environmental health and safety specialist and the social specialist (Figure 1). Furthermore, at least one additional MoA field staff member with health, safety and environmental (HSSE) responsibilities will be located at the Makaba dam site for continuous onsite monitoring and reporting during remediation of the dam and its operation – for the lifespan of the IDSP.

The three specialists will supervise all E&S related matters for the works under the AF. This includes supervision of UNOPS and the UNOPS contractor at the Makaba dam site. This E&S supervision includes the operationalization of the dam, during which period the IDSP staff will be working with the respective local authorities, DMC and local communities, in preparation for a smooth handover when IDSP ceases to exist as a project.

The IDSP-PIU will implement capacity building and training of local stakeholders to ensure their informed cooperation in E&S matters during the remedial works and during the operational phase of the dam as well as advising the DMC.

3.1 United Nations Office for Project Services (UNOPS)

The IDSP-PIU is contracting UNOPS to implement the remediation sub-project of Makaba Dam under the AF, including the day-to-day environmental and social management and implementation of the measures described in this ESMP. UNOPS has been tasked with the design of the remedial works and the preparation of this ESMP. UNOPS will further be responsible for the preparation of the tender document and supervision of the contractor for the remedial construction works and the implementation of E&S mitigation measures. Supervision will involve the management of the contractor and liaison with and reporting to the IDSP-PIU throughout the contract period.

The UNOPS technical team will include civil engineers and a dam safety specialist. Environmental and social issues will be the responsibility of one environmental specialist, one social specialist and one ecologist. This technical team will be located at the UNOPS Sub-PIU in Lusaka, with frequent travel to the Makaba dam site.

The environmental specialist, the social specialist, and the ecologist will be involved in the environmental and social management of Makaba Dam. In addition, the team will supervise and monitor the implementation of environmental and social mitigation measures by the contractor. The team will establish a regular supervision and monitoring schedule, including site visits, and will prepare and submit quarterly environmental and social monitoring reports to the IDSP-PIU.

3.2 The Contractor and Sub-Contractors

The contractor will be responsible for carrying out the work at the site in compliance with this ESMP, in accordance with applicable Zambian laws and regulations governing environmental and social impact management, pollution control, waste management, occupational health and safety, and the World Bank OPs.

The contractor will appoint one HSSE Officer to serve at the construction site throughout the entire period and ensure implementation of the ESMP. Among other obligations, the contractor will comply with all labor and gender equality requirements on site, as specified in the ESMP, and will brief the Makaba DMCand relevant government officials through regular meetings.

The contractor is required to prepare method statements for aspects of the sub-project, and to operationalize all action and management plans as defined in this ESMP (including non-hazardous waste, hazardous materials and waste, surface and groundwater pollution, protection measures for terrestrial and aquatic fauna and flora, air quality and noise, labor and working conditions, sanitation, gender equality, GBV, provision of flow during construction, environmental remediation and rehabilitation, maintenance and monitoring). This will be outlined in the procurement documentation provided to the contractor. The contractor's method statements will be submitted to UNOPS for approval prior to commencement of work.

3.3 The Dam Community

As the owner of the dam, the dam community will be encouraged to be an active partner during the construction and operational period. The committee will be regularly consulted on a variety of issues (see stakeholder engagement section) and will be encouraged to report any grievance or misconduct by the contractor personnel to the IDSP-PIU through the GRM which has been designed for the AF activities. The DMC and community representatives, such as the headmen, will verify to ensure that the works do not cause harm to people and nature. Furthermore, stakeholder engagement, as laid out in the stakeholder engagement plan below, will be conducted by UNOPS, IDSP and the contractor, to ensure that community engagement informs the sub-project, that dam communities are well informed about the remedial works and the environmental and social mitigation measures undertaken. Stakeholder engagement ensures that dam communities are consulted throughout the construction and operational phases.

The dam is operated by a DMC, which consists of 13 community members. The Makaba dam management committee (DMC) is active; it consists of one woman and twelve men. The Makaba DMC composition and positions are shown in Appendix F. The dam management committee is a locally developed, decentralised organisation where user communities have been ceded rights and have responsibilities for managing their own resources, typically using a mix of traditional or more formalised mechanisms of contract and enforcement to define, access, exploit, maintain and share dam resources or benefits. Due to the complexity of managing dams, the management structure is widened to include public agencies such as agriculture, water resources, fisheries and forestry departments as advisors and trainers. The committee has been involved during planning, and will be continuously active during construction and operation phases. Its role will include involvement in stakeholder engagement, auxiliary sites selection, employment, ESMP implementation, operation guidelines and monitoring, operation maintenance and dam safety. The level of involvement in the maintenance and management will depend on the type of technology, the range of maintenance activities and capacity building offered to the committee. Therefore, UNOPS and IDSP have and will further inform communities of their expected obligations and contributions during consultations and training.

The headmen and the DMC conduct monitoring and sensitization activities around dam issues. The committee has set rules, which have been communicated to the users. These include tree and vegetation conservation rules around the dam. This has resulted in a good number of trees being protected. Cultivation around the dam is limited to minimize soil erosion, especially upstream. The dam has no security measures in place except for the DMC's constitutional regulations, which are being adhered to so far.

Upon completion of the remedial works, there will be a hand-over of the management, operation and maintenance of the dam to the Makaba DMC. In order to successfully operate the dam, and limit impacts on people and environment, the DMC members require further capacity building and training. Training will include issues such as dam safety management/ structural deterioration; gender equality; health and safety issues, erosion control and conservation (see training plan below).

MoA has representatives at the dam site that will continuously monitor the remedial works and report to IDSP.

4 Environment and Social Baseline Conditions

4.1 Physical Conditions

4.1.1 Geology

Makaba Dam is located in the Kafue Flats of Namwala District, which form a vast floodplain with an altitude between 970 and 1,000 masl. The dam is located at an altitude of 1,052 masl at the inlet to the reservoir and 1,036 masl at the outlet In terms of soils, the arenosols and less commonly vertisols and gleysols cover the cenozoic rocks under the sub-project area. Arenosols are sandy-textured soils that are low in humus and in subsurface clay content, they are highly permeable. They are susceptible to wind and water erosion, as can be seen around the spillway channel and borrow area. In addition, no top-soiling or grassing exists on the downstream embankment slope. These opened-up areas have led to sedimentation and loss of biodiversity and soil (Figure 2).[4] The dam catchment area includes intense farming activities leading to natural vegetation and habitat loss, causing soil loss and subsequent sedimentation of the dam and the stream.

The other major sources of siltation and soil movements are the livestock watering points all around the basin and downstream. There were no visible top soil stockpiles on the site. These were possibly buried during excavations. The proposed works area is within the disturbed spillway and embankment zones.

Figure 2: Open slopes and gullies along spillway and towards embankment

4.1.2 Surface Hydrology

The Namwala District is largely drained by the Kafue River in the northern and its tributaries in the western, southern and eastern parts. The dam collects water from a large catchment area, which UNOPS confirmed to be This has been 69Km^2 in size. There are several perennial streams in the region with good surface drainage. Aquifers in the area have moderate water yields between 0.1-15 litres per second.

[4] This has been attributed to lack of remediation measures after prior works suspension and project closure on the dam.

The local communities claim that they mostly experience moderate rainfall compared to two decade ago, when the average rainfall was higher. The dammed stream is seasonal. There is less water in the canals downstream, in the reservoir and in the few wells used for upstream gardening as temperatures rise higher in the year. The Flood Map is shown below with a 200m buffer along the stream.

Figure 3: Flood map

The water channels and catchment area are shown below:

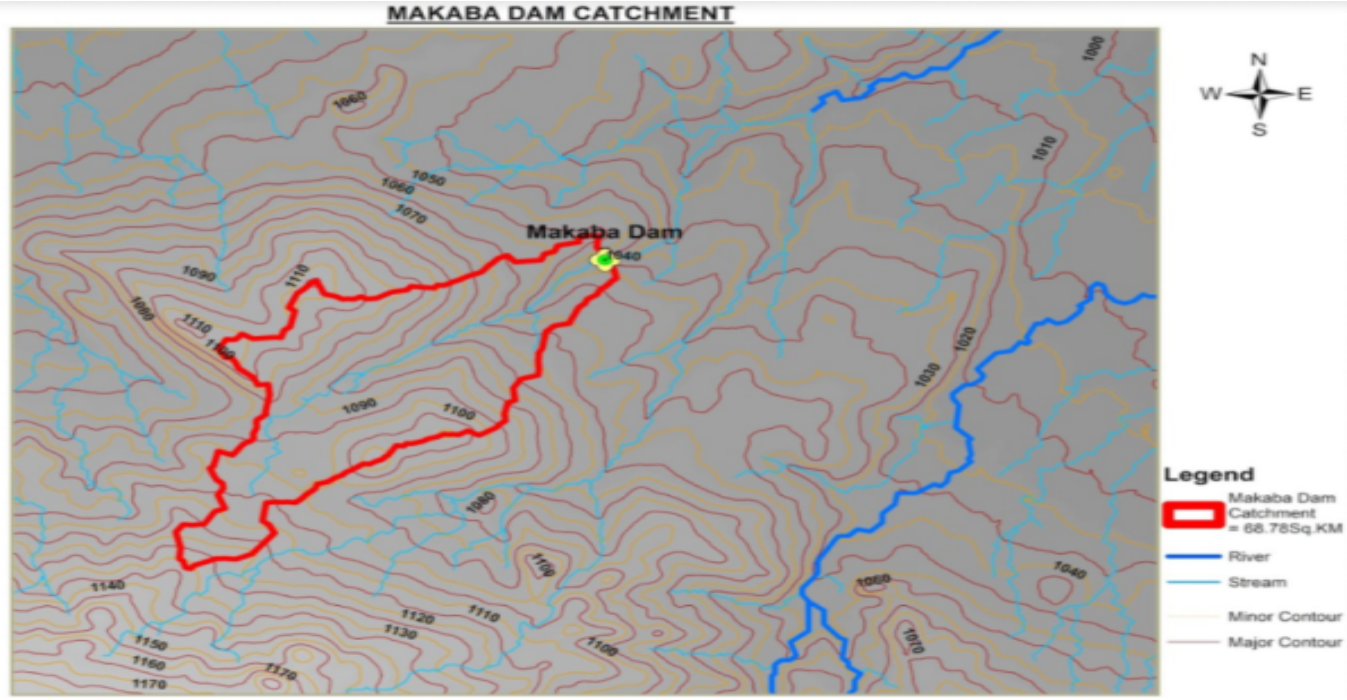


Figure 4: Catchment area

The dam has flow releases over the spillway. It also has unintended spillway seepage leading to increased and continuous downstream flows. According to the community, the Makaba Dam experiences reduced water levels in the reservoir during the hot season, but it has never dried up. This is related to the significant flows and catchment flows into the dam – mostly during the rainy season. Evident flows are shown below:

Figure 5: Downstream flows

4.1.3 Groundwater

The dam communities use groundwater resources for drinking. The water is provided by boreholes with hand-pumps or hand-dug wells that are equipped with a bucket. Common depths of boreholes are in the range of 50 m to 70 m. Hand-dug wells are willow with depths ranging from a few meters to 20 m. Namwala falls in the Kafue Flats topographic feature of Southern Province[5]. Groundwater supply is reliable because the area lies in an unconsolidated clastic sediments groundwater system. Very few (less than 1%) unsuccessful boreholes are reported.[6]

4.1.4 Surface Water and Groundwater Quality

The water quality is aesthetically pleasant all year round except in animal watering areas. The latter become turbid, but the solids easily settle. The turbid looking water along the banks does not spread to the rest of the basin, which may mainly be ascribed to the type of soil (Figure 6). The community uses existing canals for irrigation purposes. Where the canals do not reach, it uses buckets to water downstream gardens.

Figure 6: Water quality disparities at watering edges and the main basin

UNOPS collected water samples in 2020, upstream in the dam basin (coordinates 16° 5'59.14"S; 26°51'18.44"E). The results were taken for analysis at the University of Zambia. Table 4 below shows the water quality in Makaba Dam in comparison to other dams of the project. It demonstrates that all tested parameters fall within the permitted levels according to standards used.[7] Total or fecal coliforms were not tested at the time of the study. Their presence may be a sign of contamination and possible waterborne diseases. Possible major sources of fecal coliforms for surface waters in this area would be livestock droppings during watering and human fecal matter from open defecation and pit latrines. Comparing the Makaba Dam analytical results (Table 4) with the existing WHO drinking water guidelines and the World Bank Irrigation Water Quality Standards, the water quality generally meets the required standards. However, the turbidity level is above the permissible drinking water levels.

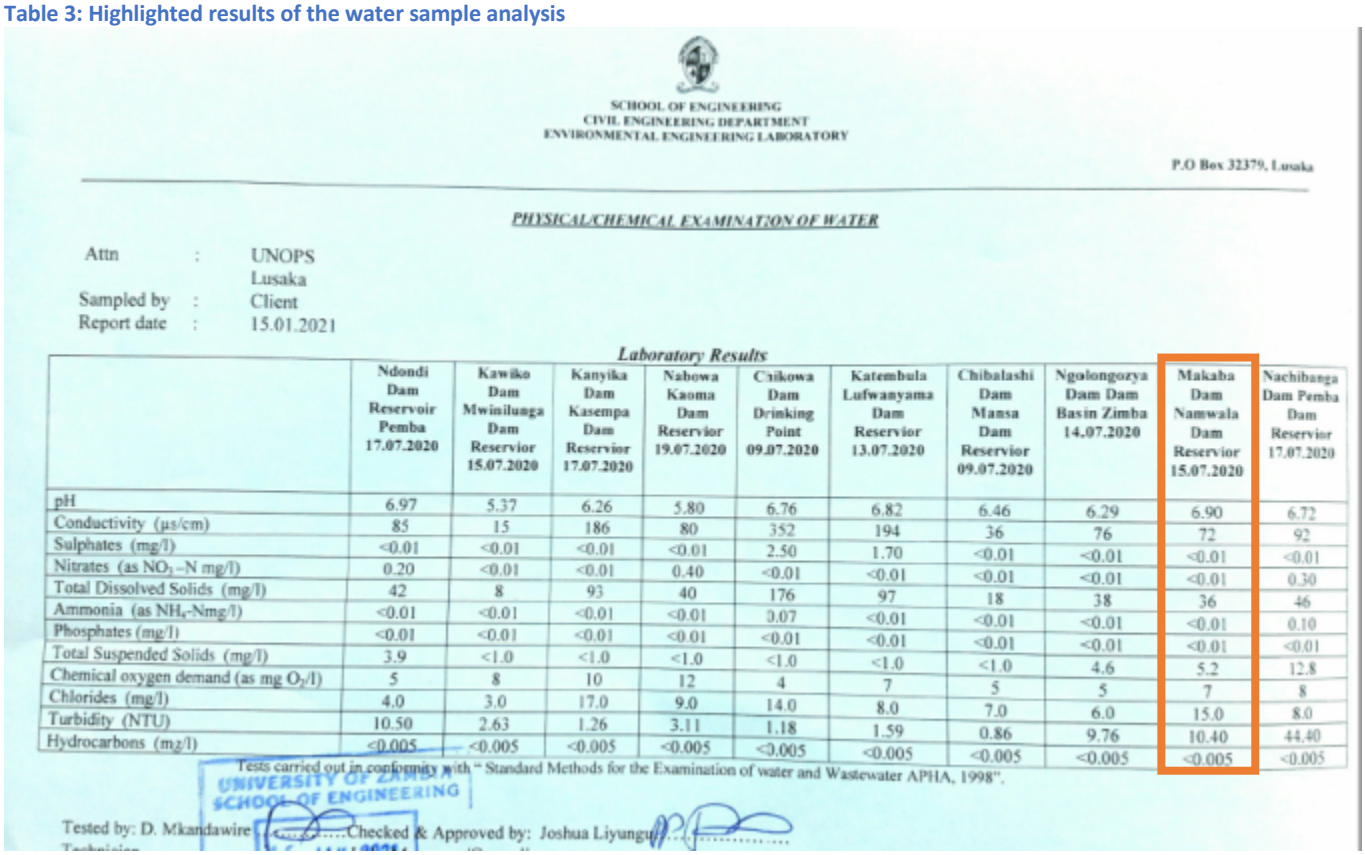
[5] The flats store, provide plentiful and clean water-Information sheet on Ramsar wetlands (2008)

[6] Groundwater resources for Southern Province, 2007

[7] UNOPS did not test for coliforms due to tight continuous site work resulting in the long duration between collection and testing which would have compromised the bacteriological results

The turbidity at the dam could be a result of the transfer of silt from the area within the dam catchment, given that there are open areas left behind by crop farming activities, and loss of soil due to overgrazing. High turbidity in the dam reservoir may chock the dam, and may limit water use and negatively impact the sustenance of the aquatic ecosystem due to potential limitations in photosynthetic processes.

Table 3: Highlighted results of the water sample analysis



SCHOOL OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT
ENVIRONMENTAL ENGINEERING LABORATORY

P.O Box 32379, Lusaka

PHYSICAL/CHEMICAL EXAMINATION OF WATER

Attn : UNOPS Lusaka
Sampled by : Client
Report date : 15.01.2021

Laboratory Results

	Ndondi Dam Reservoir Pemba 17.07.2020	Kawiko Dam Mwinilunga Dam Reservior 15.07.2020	Kanyika Dam Kasempa Dam Reservior 17.07.2020	Nabowa Kaoma Dam Reservior 19.07.2020	Chikowa Dam Drinking Point 09.07.2020	Katembula Lufwanyama Dam Reservior 13.07.2020	Chibalashi Dam Mansa Dam Reservior 09.07.2020	Ngolongozya Dam Dam Basin Zimba 14.07.2020	Makaba Dam Namwala Dam Reservior 15.07.2020	Nachibanga Dam Pemba Dam Reservior 17.07.2020
pH	6.97	5.37	6.26	5.80	6.76	6.82	6.46	6.29	6.90	6.72
Conductivity (µs/cm)	85	15	186	80	352	194	36	76	72	92
Sulphates (mg/l)	<0.01	<0.01	<0.01	<0.01	2.50	1.70	<0.01	<0.01	<0.01	<0.01
Nitrates (as NO_3-N mg/l)	0.20	<0.01	<0.01	0.40	<0.01	<0.01	<0.01	<0.01	<0.01	0.30
Total Dissolved Solids (mg/l)	42	8	93	40	176	97	18	38	36	46
Ammonia (as NH_4-Nmg/l)	<0.01	<0.01	<0.01	<0.01	3.07	<0.01	<0.01	<0.01	<0.01	0.10
Phosphates (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Suspended Solids (mg/l)	3.9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	4.6	5.2	12.8
Chemical oxygen demand (as mg O_2/l)	5	8	10	12	4	7	5	5	7	8
Chlorides (mg/l)	4.0	3.0	17.0	9.0	14.0	8.0	7.0	6.0	15.0	8.0
Turbidity (NTU)	10.50	2.63	1.26	3.11	1.18	1.59	0.86	9.76	10.40	44.40
Hydrocarbons (m_2/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Tests carried out in conformity with " Standard Methods for the Examination of water and Wastewater APHA, 1998".

UNIVERSITY OF ZAMBIA SCHOOL OF ENGINEERING

Tested by: D. Mkandawire ..... Checked & Approved by: Joshua Liyungu .....

Element	Analytical result	WHO Guidelines maximum permissible levels for drinking water	WB Irrigation Water Quality Standard[89]
pH	6.90	6.5-8.5	6.00 – 9.00
Conductivity (µg/cm)	72	1500	
Sulphates (mg/l)	< 0.01	250	
Nitrates (as NO_3-N mg/l)	< 0.01	500	
Total Dissolved Solids (mg/l)	36	1000	
Ammonia (as NH4-Nmg/l)	< 0.01	1.5	10
Phosphates (mg/l)	< 0.01	-	
Total Suspended Solids (mg/l)	5.2	-	50
Chemical Oxygen Demand (as mg O2/l	7.00	-	250

[8] The World Bank, Water Resources and Environment. Technical Note D1, Water Quality Assessment and Protection, 2003, p. 32, accessed at: http://documents1.worldbank.org/curated/en/514141468768597679/pdf/multi0page.pdf.

[9] The World Bank, General Environmental Guidelines, Pollution Prevention and Abatement Handbook, 1998, p. 438; accessed at: https://www.ifc.org/wps/wcm/connect/77a4c571-c743-48a8-9c6d-21d6ce77d017/genenv_PPAH.pdf?MOD=AJPERES&CVID=jqeDiLg.

Chlorides (mg/l)	15.00	250	
Turbidity (NTU)	10.4	5	
Hydrocarbons (mg/l)	< 0.005	-	10

A sample of the proposed contractor drinking water was collected from the local Makaba Primary School borehole and tested at the University of Zambia's Laboratory. Comparing the analytical results (Table 5) with the WHO and the guidelines by the Zambia Bureau of Standards on permissible levels for drinking water, the water quality generally meets the required standards.

Table 4: Water quality results Makaba School borehole, 2021

SCHOOL OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT
ENVIRONMENTAL ENGINEERING LABORATORY

P.O Box 32379, Lusaka

PHYSICAL/CHEMICAL EXAMINATION OF WATER

Attn : UNOPS
Lusaka
Sampled by : Client
Report date : 18.05.2021

Laboratory Results

Sample ID	Makaba Dam Wall	Makaba Dam Mid	Makaba Dam Downstream	Makaba Dam Entry	Makaba Dam Upstram	Makaba Dam Borehole
Sampling date	**15.04.2021**	**15.04.2021**	**15.04.2021**	**14.04.2021**	**23.04.2021**	**14.04.2021**
Parameter						
pH	6.78	6.64	6.39	6.39	6.52	7.29
Conductivity (µs/cm)	48	75	212	77	214	280
Sulphates (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrates (as NO_3 –N mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Alkalinity (as $CaCO_3$ mg/l)	44	56	110	42	90	110
Total Dissolved Solids (mg/l)	112	115	116	112	114	340
Ammonia (as NH_4-Nmg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phosphates (mg/l)	<0.01	0.30	<0.01	<0.01	<0.01	<0.01
Total Suspended Solids (mg/l)	5.2	4.3	5.1	4.6	4.3	<1.0
Chemical oxygen demand (as mg O_2/l)	3	3	4	3	3	3
Chlorides (mg/l)	23.0	17.0	30.0	15.0	10.0	25.0
Turbidity (NTU)	23.00	14.90	21.60	17.20	17.70	3.77
Hydrocarbons (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Tests carried out in conformity with " Standard Methods for the Examination of water and Wastewater APHA, 1998".

Element	**Analytical result**	**WHO Guidelines maximum permissible levels for drinking water**
pH	7.29	6.5-8.5
Conductivity (µg/cm)	280	1500
Sulphates (mg/l)	-	250
Nitrates (as NO_3-N mg/l)	< 0.01	500
Alkalinity	110	
Total Dissolved Solids (mg/l)	340	1000
Ammonia (as NH4-Nmg/l)	< 0.01	1.5
Phosphates (mg/l)	< 0.01	-
Total Suspended Solids (mg/l)	< 1.0	-
Chemical Oxygen Demand (as mg O2/l	3.00	-

Chlorides (mg/l)	25	250
Turbidity (NTU)	3.77	5
Hydrocarbons (mg/l)	< 0.005	-

4.1.5 Seismology

Earthquakes can result in damage to and failure of man-made structures, such as dams. When constructed in areas of high seismicity, dams may pose a significant risk to downstream life and property. Seismic waves may cause deformation of dam embankments, a loss of foundation strength and instability of the dam.

For Zambia, previously conducted studies on seismic hazard assessments estimate the Peak Ground Acceleration (PGA), which is the maximum ground acceleration during an earthquake shaking at a location, to be between 0.3 to 0.9g[10] (equal to magnitudes 2.943 to 8.829m/s^2). This poses a very low risk. Only three major occurrences have been recorded in Southern Zambia between 1910 and 2016. Two of them took place around Lake Kariba and one in Southern Province (Table 6).

Table 5: Major earthquakes in Zambia (Zambian Seismic Network Country Report, 2017)

DATE	TIME	LAT	LONG	MAGNITUDE	REGION
13/12/1910	11:34	8	31	7.1	South Of Tanganyika
13/12/1942	13:40	11.4	34.5	6.7	Western
25/09/1963	07:03	16.73	28.4	6.4	Lake kariba
18/07/1986	15:07	16.36	28.48	5.4	Lake kariba
10/05/1991	01:12	17.35	24.98	4.8	sw of Mulobezi
13/02/2010	16:00	13.4	30.84	5.3	Serenje
18/01/2011	16:31	8.6	31.74	5.7	Mbala
21/07/2011	15:55	15.96	25.98	5.2	Itezhi-tezhi
02/10/2013	14:23	13.4	31.8	4.5	West of Chipata
3/11/2014	18:25	10.97	29.69	5.3	Lubwe, Luapula
19/08/2015	00:15	9.66	28.61	5.1	Luapula Province
09/01/2016	03:05	16.046	28.55	4.6	Lusaka & southern Provinces

According to the US Geological Survey, the seismic hazard level is very low in the area of Makaba Dam. It is within the range of 0.4-0.8 m/s^2 (with 10% excess probability in 50-year PGA) (Figure 7).[11] Unlike large dams, small dams do not induce seismicity.[12] Furthermore, historical data on the performance of previously studied dams have shown

[10] g= Gram force 1g=9.81m/s^2

[11] Zambian seismic network country report, US geological survey, 2017

[12] Tosun, Hassan, Earthquake engineering. From Engineering Seismology to Optimal Seismic Design of Engineering Structures, accessed at: https://www.intechopen.com/books/earthquake-engineering-from-engineering-seismology-to-optimal-seismic-design-of-engineering-structures/earthquakes-and-dams

that embankment dams perform well even under strong ground motions. Well-built and well compacted embankment dams improve dam safety and can withstand moderate earthquake shaking with a PGA greater than 1.96m/s^2.

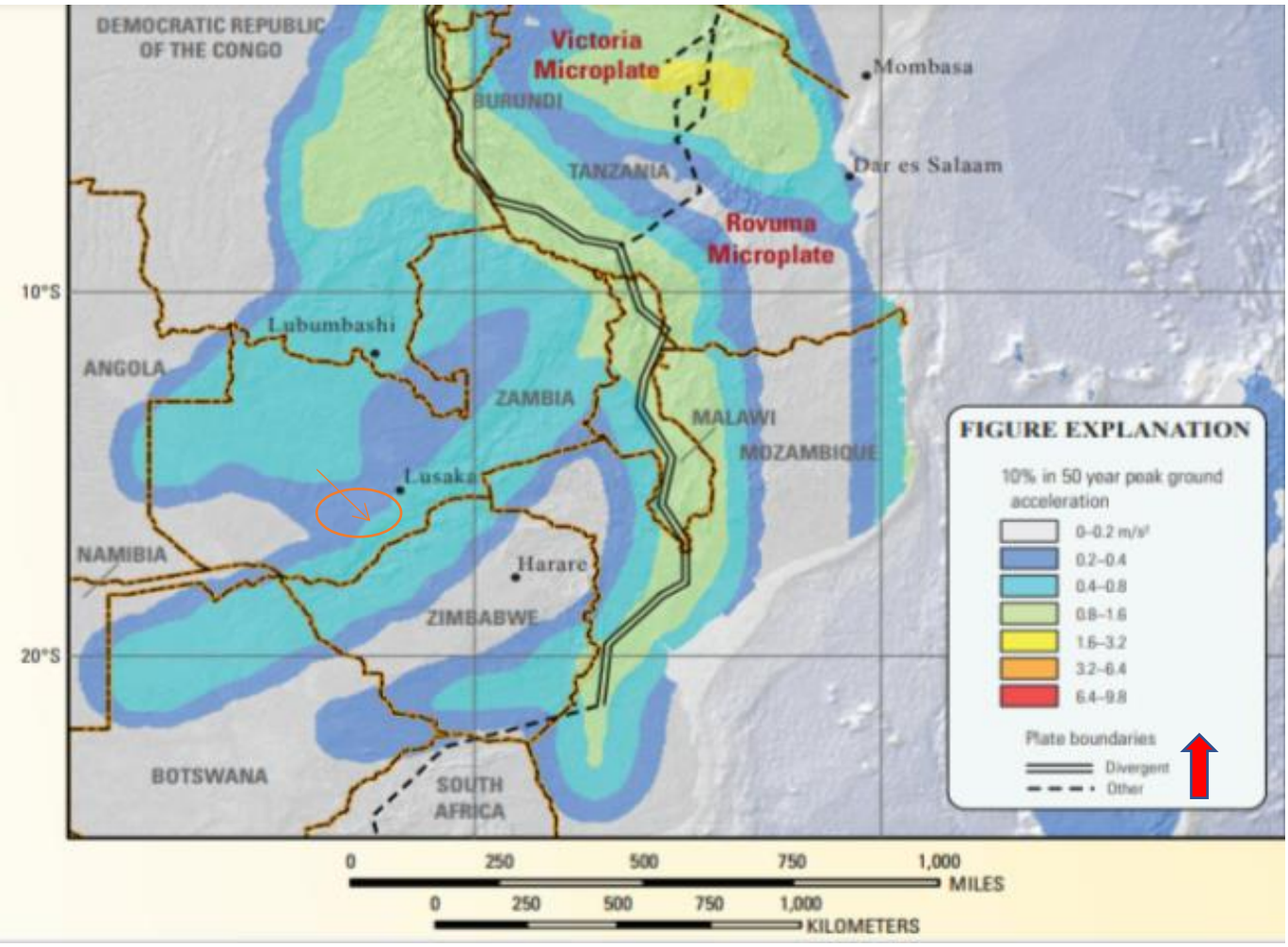


Figure 7: Seismic hazard, US Geological Survey 2013

4.1.6 Climate and Climate Change

The climate in the Southern Province of Zambia can be described as humid subtropical, with dry winters and hot summers. Three distinct seasons can be observed:

- a rainy season - a warm wet season from October to May
- a cold season - a mild to cool dry season from May to August
- a hot season - a hot and dry season from September to November.

Rainfall: The Southern Province is located in the Agro-ecological zone[13], which is characterized by an annual average rainfall of less than 800mm. According to data obtained from four Zambia Meteorological Department (ZMD) stations in Southern Province, the mean seasonal rainfall between October and May varies between 700 and 800

[13] These are 3 zones based on rainfall amounts in Zambia, but also incorporate soils and climatic characteristics. Zone I receives less than 800mm annual rainfall, Zone II receives between 800-1000mm of annual rainfall and Zone III receives between 1000-1500mm of annual rainfall.

mm. The graph below shows values of average monthly rainfall and average temperatures for Choma, which is the nearest station to Makaba Dam, 80 km to the south.

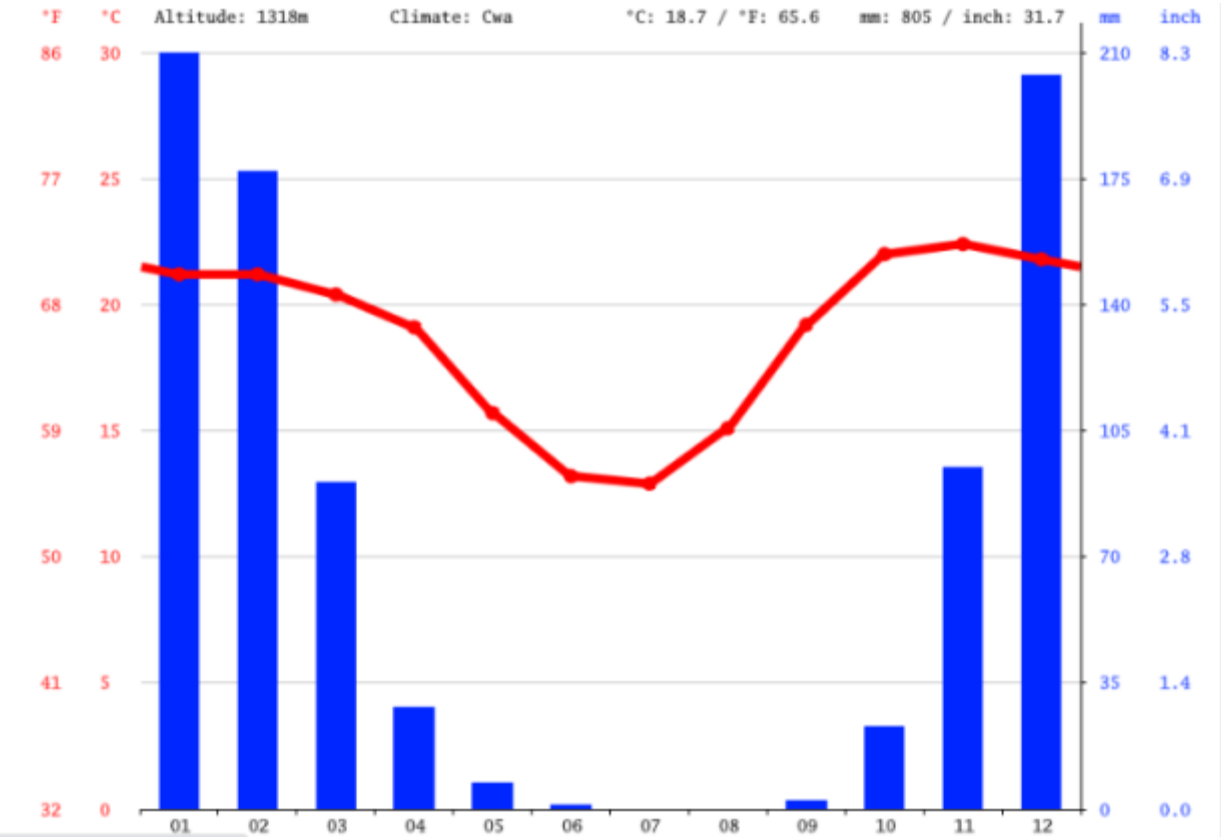


Figure 8: Average rainfall per month, Climate-data.org

Temperature: The mean annual temperature measured at Choma is 18.7°C. The average monthly temperature throughout the year is shown in Figure 9. The hottest month is November and the coldest is July.

Humidity: Namwala experiences a 10-year period average of 85% humidity and 50% cloud cover.[14]

[14] Namwala, Luapula, Zambia Weather Averages | Monthly Average High and Low Temperature | Average Precipitation and Rainfall days | World Weather Online

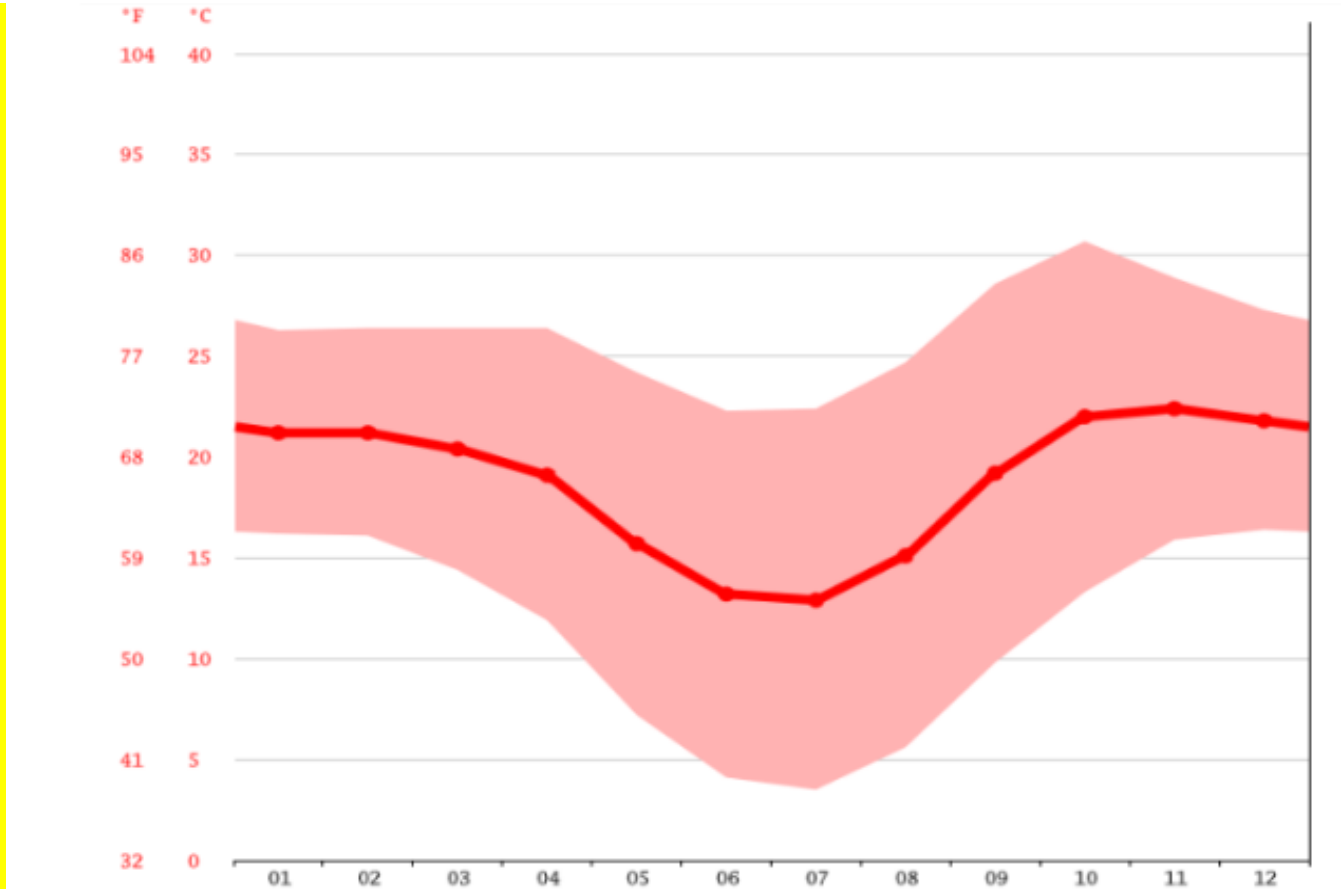


Figure 9: Average temperature per month, Climate-data.org

According to the World Bank[15], Zambia's climate is highly variable and in the last few decades it has experienced a series of climatic extremes, e.g. droughts, seasonal floods and flash floods, extreme temperatures and dry spells, many of these with increased frequency, intensity and magnitude. Their impacts on the country are evident in climate-induced changes to physical and biological systems which increasingly exert considerable stress on the country's vulnerable sectors. Climate change has had adverse impacts on food and water security, water quality, energy and the sustainable livelihoods of rural communities. Coupled with poverty, these factors also limit economic development.

According to a study by UNDP from 2008[16], climate change is set to increase food insecurity in agro-ecological zones I and II in Zambia. Agro-ecological zone I, which stretches along the southern border, has the least rainfall. Since the late 1980s, this zone has been subject to a tendency for a later onset and earlier withdrawal of rains, as well as more frequent droughts. In the last seven years of this decade, Zambia has had droughts in the rainy seasons of 2000/01, 2001/02 and 2004/5. Floods become more widespread too: over half of Zambia's districts were affected in the last few years – 2005/6, 2006/7 and 2007/8 being the most recent - some for the first time.

With very little infrastructure for water collection, Zambia is overwhelmingly dependent on rainfall. Water needs are met through boreholes and wells where available, or alternatively, through rivers. The Makaba Dam is now

[15] World Bank Climate Change Knowledge Portal, Country: Zambia, accessed at: https://climateknowledgeportal.worldbank.org/country/zambia

[16] UNDP Climate Change Adaptation, Adaptation to the Effects of Drought and Climate Change, accessed at: https://www.adaptation-undp.org/projects/ldcf-drought-zambia

an important adaptation infrastructure for the communities' water storage and use in a time when climate change is experienced. The water is not used for human consumption. Climate change projections point to an increase in temperature and a change in patterns of rainfall, leading to prolonged droughts and localized flooding. Agro-ecological zone I is already a marginal area for the cultivation of crops due to low annual rainfall. Climate change is superimposed on unsustainable land-use practices, such as forest clearing for agriculture and charcoal production, and combined with poor livestock management systems has caused severe land degradation. The practices affect the dam sustainability. The communities in Southern Province depend mostly on cattle for their livelihood.

Climate projections for Zambia[17] are shown in Figure 10 below, for which the World Bank has used the Coupled Model Intercomparison Project, Phase 5 (CMIP5) models included in the IPCC's Fifth Assessment Report (AR5). Key projected climate trends are summarized below:

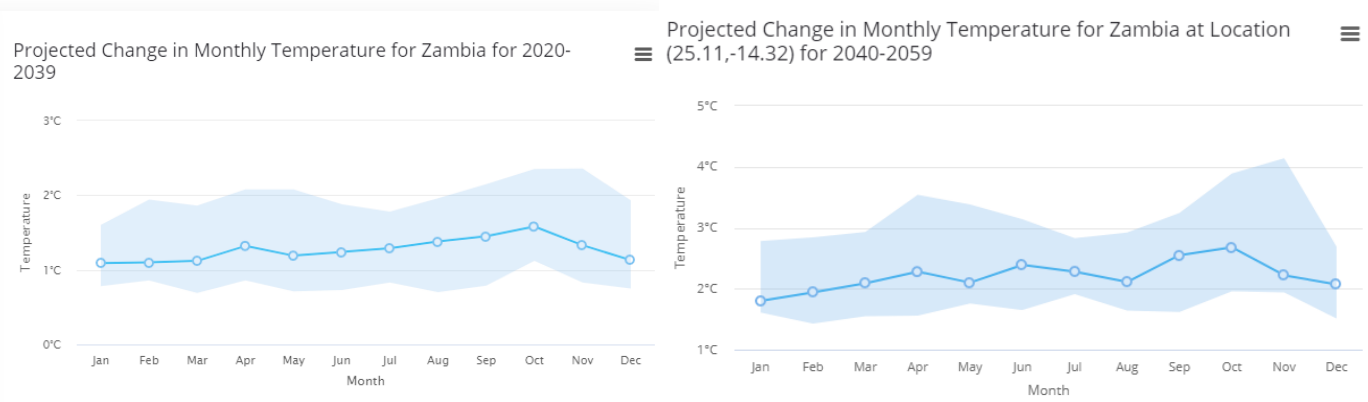
Temperature

- Mean annual temperature is projected to increase by 1.2-3.4°C by 2060.
- Hot days are projected to increase by 15-29%. Hot nights are projected to increase by 26-54%.

Precipitation

- Projections of mean rainfall do not indicate large changes in annual rainfall. Seasonally, the range of projections from different models is large, but indicates decreases in September-November and increases in December-February rainfall respectively.
- The proportion of rainfall from heavy events is expected to increase.

Continued changes in climate may mean continuous impacts on biological, social and physical environments around the dam.



[17] World Bank Climate Change Knowledge Portal, Country: Zambia, accessed at: https://climateknowledgeportal.worldbank.org/country/zambia

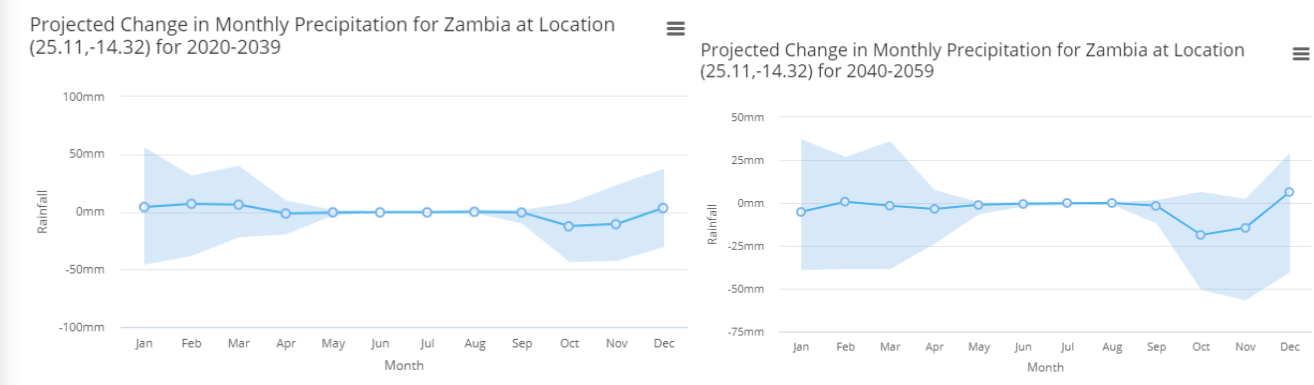


Figure 10: Projected changes in monthly temperatures and precipitation for Zambia 2020-2059

4.1.7 Land Use

The main land use around Makaba Dam is characterized by agriculture and rural settlements (Figure 11). A primary school, legacy sites such as roads, irrigation area, open slopes, a broken canal and a borrow area are located around the dam.

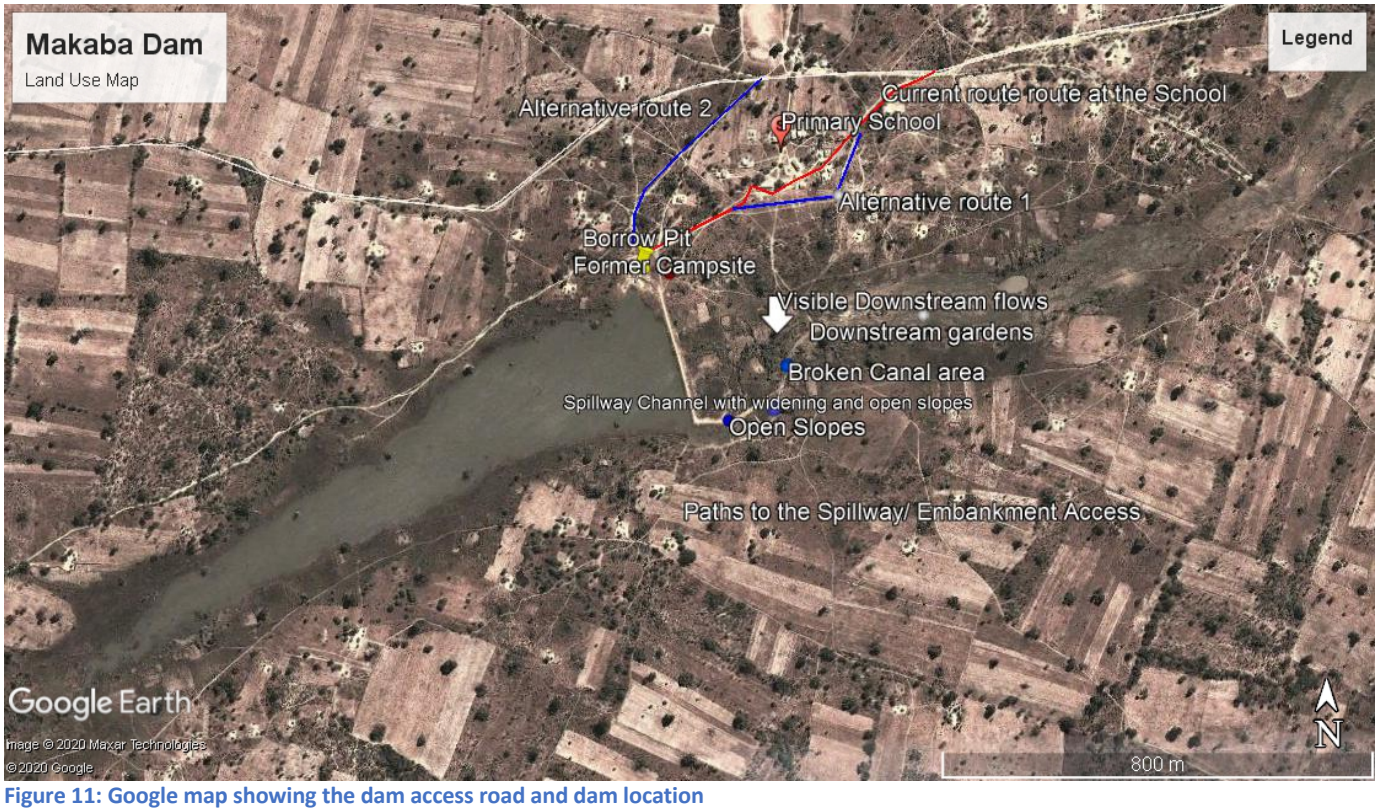


Figure 11: Google map showing the dam access road and dam location

4.2 Biological Conditions

A detailed biodiversity study was undertaken by UNOPS for Makaba Dam and a BMP prepared, annexed in Appendix J. .

4.2.1 Terrestrial Flora and Fauna

The sub-project site is not located in a protected area. Habitats have been modified significantly by settlements, cultivation, bush clearing for charcoal and firewood and overgrazing. The area of influence is shown on the land use map: Part 1-upstream before the basin; Part 2- basin area; Part 3-downstream beyond the dam wall.

Figure 12: Forest cover around the site, Google Earth 2020

In terms of forest cover, ecological importance and sensitivity the following is observed: overall predominant trees in the 3 sections are *Brachystegia, Julbernardia, Combretum, Syzygium* and *Acacia*. The grass includes Thatching grass (*Hyparrhenia hirta),* Rhodes grass *(Chloris gayana),* Russet grass (*Loudentia simpex),* Feather fingergrass *(Chloris virgate)*, Digit grass *Digitaria eriantha*, and Tussock grass *Heteropogan*.

- Parts 1 and 2 of the dam are ecologically the most important with the most cover (Figure 12). Part 1 is the most vegetated section with significant habitats though with farmland fields in some sections.
- Part 2 of the dam has moderate to significant vegetation around the dam with mature trees and primary to secondary succession upstream. Around the dam, the first storey has good land cover with abundant grass and numerous regenerates. Farmers cut down regenerates to fence their vegetable gardens in the wetlands (to protect the gardens from cattle, which are prevalent in the area).
- Part 3 of the dam is deforested due to settlements, fields and gardens.

The communities are extensive crop farmers in addition to livestock farmers. Therefore, the dam catchment is heavily farmed (Figure 12); the land around the dam (about 200m from the stream) has been cleared for crop fields; and the upstream and downstream areas of the dam have gardens. For the upstream and downstream gardens located along the stream, trees have been cut for fencing to prevent animal crop attacks (Figure 13).This has caused the present habitat loss and presents erosion potential, which may be accelerated and may lead to sedimentation of the dam if current detrimental land use activities continue and catchment management is not implemented.

Cultivation effects on the catchment terrstrial habitats

Figure 13: Downstream and upstream gardens with tree fencing

According to Forest Watch (2020)[18], from 2001 to 2019, Southern Province lost 17.0kha[19] of tree cover, equivalent to a 5.6% decrease in tree cover since 2000, and 2.50Mt[20] of CO_2 emissions.

From 2001 to 2019, Namwala lost 4.24kha of tree cover, equivalent to a 6.0% decrease in tree cover since 2000, and 571kt[21] of CO_2 emissions (Figure 14). This has led to habitat loss in the district. The CO_2 emissions due to tree loss further influence climate change (section 4.2.6).

[18] Forest Monitoring, Land Use & Deforestation Trends | Global Forest Watch; Interactive World Forest Map & Tree Cover Change Data | GFW (globalforestwatch.org)

[19] Thousand hectares

[20] Million tons

[21] kiloton

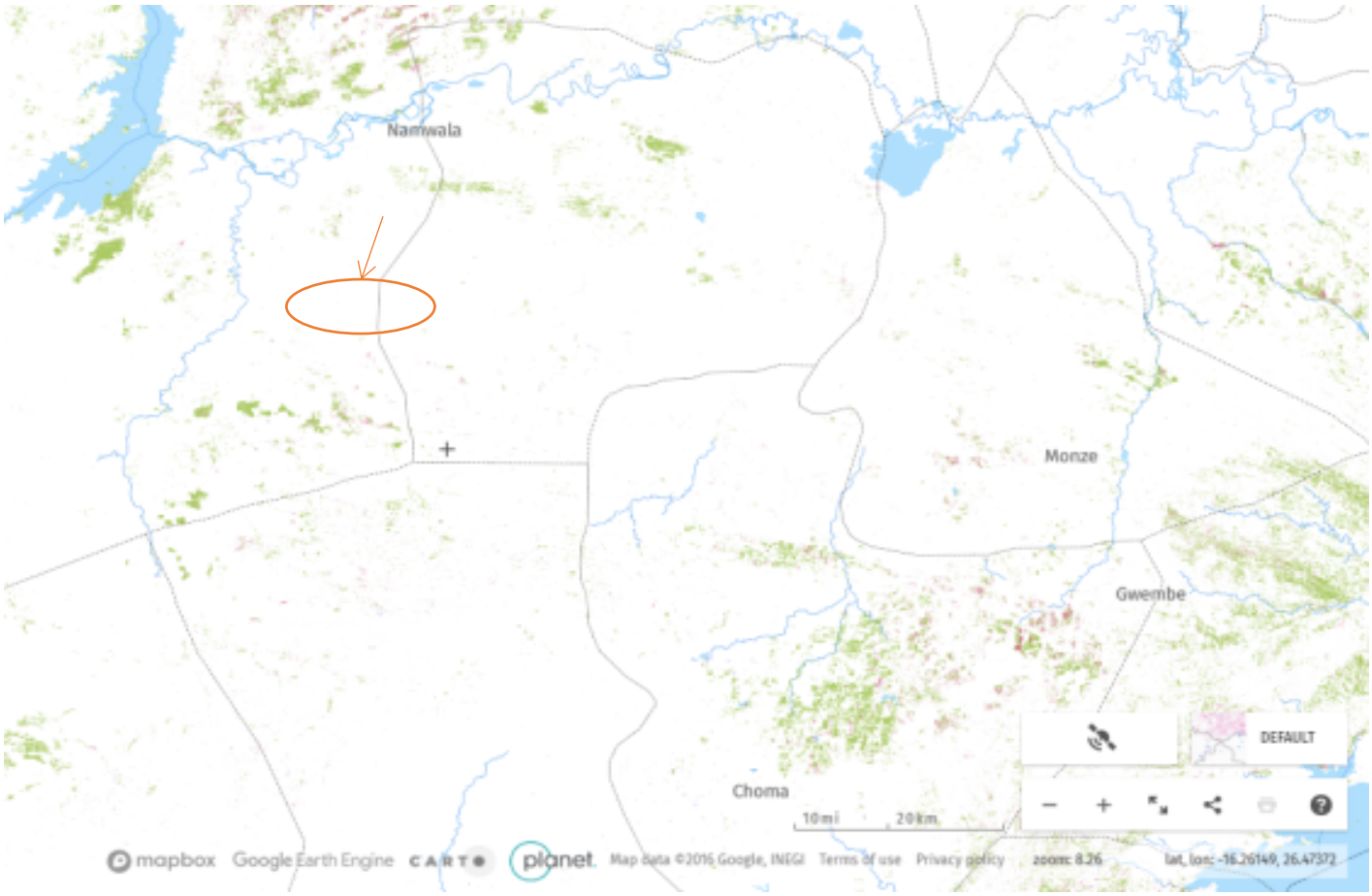


Figure 14: Namwala area forest cover, Forest Watch

The dam site is 38 km southwest of the Lochinvar National Park and over 80 km from the Blue Lagoon National Park, both of which are associated with the Kafue Flats. The Kafue Flats (locally called 'Butwa') are a vast area of swamp, open lagoons and seasonally inundated flood-plains on the Kafue River in the Southern, Central and Lusaka Provinces of Zambia. They comprise a shallow flood plain, 240 km long and about 50 km wide, flooded to a depth of less than a meter in the rainy season (deeper in some lagoons and permanently swampy areas), and drying out to a clayey black soil in the dry season. Within a 50 km radius and further in the Kafue Basin, the fauna and flora was studied by COWI (COWI 2017), the IDSP ESA, 2020 (Table 7), and by UNOPS in 2020 and 2021. UNOPS' detailed findings are presented in the annexed BMP (Annex J). During the UNOPS field visits, the fauna listed in the ESA was not seen around the dam site. Most of the listed fauna in the ESA appear to be inhabitants of the Kafue Flats.

Table 7: Species of conservation concern- terrestrial fauna species recorded in IBAT within a 50 km radius of the Makaba dam site, ESA 2020

Common Name	Scientific name	Species of Conservation Concern
Mammals		
Black Rhinocerous	*Diceros bicornis*	CR
African wild dog	*Lycaon pictus*	EN
Kafue mole rat	*Fukomys kafuensis*	VU
Hippopotamus	*Hippopotamus amphibius*	VU
African elephant	*Loxodonta africana*	VU
Lion	*Panthera leo*	VU

Leopard	*Panthera pardus*	VU
Temminck's pangolin	*Smutsia temminckii*	VU
Birds		
White-backed vulture	*Gyps africanus*	CR
Hooded vulture	*Necrosyrtes monachus*	CR
White-headed vulture	*Trigonoceps occipitalis*	CR
Steppe eagle	*Aquila nipalensis*	EN
Madagascar pond-heron	*Ardeola idae*	EN
Grey crowned crane	*Balearica regulorum*	EN
Cape vulture	*Gyps coprotheres*	EN
Lappet-faced vulture	*Torgos tracheliotos*	EN
Black-cheeked lovebird	*Agaprnis nigrigenis*	VU
Tawny eagle	*Aquila rapax*	VU
Southern ground-hornbill	*Bucorvus leadbeateri*	VU
Wattled crane	*Bugeranus carunculatus*	VU
Slaty egret	*Egretta vinaceigula*	VU
Zambian barbet	*Lybius chaplini*	VU
Martial eagle	*Polemaetus bellicosus*	VU
Secretarybird	*Sagittarius serpentarius*	VU

Existing terrestrial species as confirmed by the initial rapid UNOPS site assessment and engagement with authorities and communities are shown below: the detailed list is shown in Appendix J.

Table 6: Birds reported at Makaba Dam

Common Name	Scientific name	IUCN Status and species of Conservation Concern
Birds		
Painted Snipe	*Rostratula benghalensis*	LC
Squacco Heron	*Ardeola ralloides*	LC
Yellow-Billed Egret	*Ardea brachyrhyncha*	LC
Black winged stilt	*Himantopus himantopus*	LC
Sacred Ibis	*Threskiornis aethiopicus*	LC
Marsh Owl	*Asio capensis*	LC
Fulvous Whistling Duck	*Dendrocygna viduata* *Dendrocygna bicolor* *Anas undulata*	LC
Wattled crane	*Bugeranus carunculatus*	VU
Slaty egret	*Egretta vinaceigula*	VU
Zambian barbet	*Lybius chaplini*	VU
Malachite kingfisher	*Corythornis cristatus*	LC
Amphibian and Reptiles		
Monitor Lizards	*Varanus niloticus*	LC
Marsh or Swamp Terrapin	Pelomedusa subrufa Pelusios sinuatus	LC

4.2.2 Natural and Critical Habitats

The Makaba dam area has been extensively transformed by cultivation. The dam is not in a protected area. The records of hippopotamus and wild dog described by WRDP (2016), and the additional mammal species, including elephant, that are listed by IBAT, are representative of the National Parks on the Kafue Flats, 20 km to the north east of the dam.

4.2.3 Aquatic and Semi Aquatic Fauna

The Namwala District is home to the Ila people and the fishing communities of the Baatwa. The surface water resources in the district attracted people to settle along the water resources. The most important resource for the Ila has been the rich ecosystem of the wetlands of the Kafue Flats with the undulating flood plains.[22] According to the ESA, the Makaba river system may still be associated with aquatic species of conservation concern (Table 8). The river is a part of the Kafue drainage system, which is known for two vulnerable cichlids, Three spotted bream (*Oreochromis andersonii)* and Green headed bream (*Oreochromis macrochir)*, and the endemic killifish, Kafue Killifish (*Nothobranchius kafuensis)*.

Table 7: Species of conservation concern, aquatic fauna species recorded in IBAT within a 50 km radius of the Makaba dam site, ESA 2020

Common Name	Scientific name	Species of Conservation Concern
Fish		
Threespot tilapia	*Oreochromis andersonii*	VU
Green headed bream	*Oreochromis macrochir*	VU

Existing aquatic species as confirmed by the initial rapid UNOPS site assessment in 2020, and engagements with authorities and communities: The BMP enhances conservation of flora and fauna during and after the remedial works.

Table 8: Aquatic species of the Makaba Dam

Common Name	Scientific name	IUCN Status and the Species of Conservation Concern
Aquatic species		
Red breasted Bream	*Tilapia rendallii*	LC
Three spot Tilapia	*Oreochromis andersonii*	VU
Nile Tilapia	*Oreochromis niloticus*	LC
Barbel Fish	*Clarias gariepinus*	LC
African Catfish	*Clarias gariepinus*	
Bottle nosed fish	*Mormyrus sp*	LC
Freshwater crabs	*Potamonautes*	LC
Amphibian and Reptiles		
Monitor Lizards	*Varanus niloticus*	LC
Marsh or Swamp Terrapin	Pelomedusa subrufa Pelusios sinuatus	LC

4.2.4 Fishing Practices

The Makaba dam reservoir has fish stocks provided by the Department of Fisheries. Three Cichlids are recorded,

[22] The Namwala Trust. About Us | NACTT (namwalatrust.org)

namely *Oreochromis niloticus, Tilapia rendallii* and *Oreochromis andersonii,* but despite fishing activities by the community over the years there are no accurate catch statistics available. The communities indicate that the fish levels and levels of original fish species are still high. Test fishing surveys to determine catch quantities and dam quantities have not been conducted by the Department of Fisheries. Communities conduct seasonal fishing to allow for breeding; they adhere to the national fish ban periods which vary (e.g. 2021 February to May). The quantities of fish are limited to family portions and fishing methods are limited to hooks by the DMC. Nets are not allowed due to the fear of fish depletion.

4.2.5 Ecosystem Threats

Threats to the local aquatic resources include overfishing and harvesting although this does not appear to be a serious problem in Makaba Dam. Competition from introduced alien species is a significant threat to the natural fish populations, especially since *O. niloticus* is present in the catchment and is likely to impact negatively on all of the naturally occurring species. The dam poses an uncontrolled breeding environment for the *O. niloticus*.

The extensively farmed areas in the dam catchment, accompanied by the clearing of most of the natural forest cover, are likely to be increasing downstream sediment loads into the dam and river. Details of the threats to the river system and the threatened aquatic fish species are clearly defined in the BMP, which covers both the terrestrial and aquatic scope to verify the findings of the IBAT and provide specific details of the species found in the project area.

4.3 Socio-economic Conditions

4.3.1 Social Conditions around the Dam

Makaba Dam is located in Chitongo Ward, Namwala District of the Southern Province, about 80 km north of Choma, in Namwala District. The dam is located at latitude S16.100488° and longitude E26.855649°. Chitongo Ward has an estimated population of 5,000 with 73 households. Around the dam, 3 villages are located upstream of the dam, and 5 downstream. Each village has a Headman administering the settlement. Approximately 600 inhabitants live in each village. Inhabitants are organized in extended families.

The dam is accessed off the M11 80km Choma-Namwala Road. A 7 km gravel access road to the dam exists, but is generally in poor condition, as it has eroded over the years and was not rehabilitated by the previous constructor. The road goes through a school, which is located close to the dam. People living close to the dam use a pedestrian path over the dam embankment to access social service, including the Makaba primary school, Chitongo health centre, Chitongo sub-centre and the main Choma- Namwala tarred road.

Access to services is inhibited by a lack of all-season access over the dam embankment and spillway. When the access is water logged, there is no crossing for a number of days. The affected groups of the population include school children and families that cannot access the available social and health services, including expecting mothers. Due to the poor road condition from the Choma-Namwala junction to the dam, not many vehicles can reach the dam. People make use of bicycles or ox carts to transport their garden produce to the markets. The nearest markets in Choma and Namwala are 80km away.

The main dam usage consists of fishing, irrigation, livestock watering and brick molding. Most community members in the area own two pieces of land in either one or two locations. It is common to own one piece of land along the stream used for cultivation in the dry season, and an upland portion used for rain fed crops.

The main crops grown upstream include maize, sunflower, groundnuts, sweet potatoes, cotton and cowpeas. There are thriving gardens on both banks downstream, where a wide range of vegetables is grown. Most families also own cattle and small animals such as goats, pigs and fowl, from which they maintain their livelihoods and earn an income. The dam was constructed with canals, which are used for irrigation purposes. However, the communities would like to engage in further irrigation activities for improvement of their livelihoods. They propose canal elongation for this reason. Furthermore, canals are narrow, and villagers use cups to scoop water for irrigation. Gardens are log-fenced against livestock, which is destructive during stock watering.

Local communities are more farming than fishing communities. Fishing for household and for commenrcial purposes has become popular around the dam. Fishing regulations at the dam are in place, and the Department of Fisheries has conducted relevant training for the local communities.

The local communities mainly draw their drinking water from the boreholes and shallow wells near Makaba Dam. The dam water is not used for drinking water. Boreholes have been supplied for this purpose by the Catholic Church, the District Council and World Vision NGO. The surface water is used mainly for washing and other domestic and economic uses, like irrigation and livestock watering.

4.3.2 Administration of Water and the Dam

A DMC is currently active and in place, consisting of 1 woman and 12 men. If anything needs to be procured in relation to the dam or irrigation, the dam farmers and users contribute cash, which is collected and administered by the DMC. This takes place on a needs basis, there is no monthly contribution. The DMC also enforces some traditional rules, such as the prevention of tree cutting around the dam.

The committee indicated that it requires further guidance and training in operation and dam use issues. Strengthening and capacity building of the existing committee can ensure that communities can benefit fully from the irrigation water supply. Similarly, beneficiaries would benefit from increased training to improve their knowledge on irrigation agriculture and promote income generation.

4.3.3 Gender Equality, Gender-Based Violence and Sexual Exploitation & Abuse

Among the Makaba dam communities, traditionally both, men and women can own land including gardening land. Procedures of land usage and allocation are the same for both genders. However, community members claim that women are not equal and there is a lack of women's empowerment in their communities. While male respondents claimed that more women join committee meetings, female respondents in Focus Group Discussions indicated that the men in their communities do not allow them to work. The Department of Community Development stated that women still face many inequalities in society, but that they increasingly participate in activities and decision-making fora. However, more capacity building opportunities are required, and gender mainstreaming sensitization activities in the community would be welcomed in order to include women better.

Gender-Based Violence (GBV) exists among the dam communities, but it usually not reported, as reporting comes with significant social stigma. Women fear discrimination and the failure of the marriage if they report cases of domestic violence. Generally, an estimate of 1 in 5 women in Zambia experience some form of sexual violence at some point in their lives.[23] In the Demographic and Health Survey of 2013-2014, 43% of women age 15-49 claimed to have experienced physical violence at least once since age 15; and 37% experienced physical violence within the 12 months prior to the survey. 47% of married women of the same age category report to have experienced physical, sexual and/ or emotional violence from their current or most recent husband or partner.[24] Alcohol and living in high-

[23] Chidoori Rumbidzai Elisabeth, Putting Women First – Zambia's Anti Gender Based Violence Act from 2011, p. 1
[24] USAID, UNICEF, UNFPA, CDC, Zambia: Demographic and Health Survey 2013-2014, p. 273

density areas have been identified as key issues contributing to higher rates of GBV.[25] Other factors contributing to GBV are sexual cleansing rituals, initiation ceremonies, women's economic dependence socialization of boys and girls, inadequate laws, lack of law enforcement, and intimate partner violence.[26] A baseline study conducted by Overseas Development Institute (ODI) in Zambia captured some key definitions of the types of GBV, such as women being beaten (usually by their spouse), men engaging in forced sexual intercourse with young children, women being forced to have sex, mistreatment of children including through labor, forced early marriage, and women's rights being infringed.[27]

The same baseline mentioned as first address in GBV cases the Victim Support Unit in the Police service, although there seems to be doubt in their efficiency.[28] Key challenges for preventing and responding to GBV are that most cases go unreported, because survivors are reluctant to report them. On the supply side, infrastructure, shelters and transport, have critical gaps. In absence of shelters, the safety of survivors cannot be guaranteed. Prevention activities are still not sufficient to have a significant impact.

In April 2011, Zambia passed the Anti-Gender Based Violence Act no.1 of 2011. The Act offers a comprehensive framework for protection, the prosecution of perpetrators, and supports the means of survival for victims. It established a fund to assist survivors; and it called for the establishment of shelters to support survivors, as well as it regulated monetary relief for them.

As a result of the Act, the Government has established 3 shelters across the country; a Police Victim Support Unit, as well as a series of one-stop centers across the country: At Mtendere and Chawama clinics in Lusaka; Buchi Clinic in Kitwe; Chipata Hospital; Mazabuka District Hospital; Livingstone District Hospital; Kabwe District Hospital; Ndola Central Hospital.

UNICEF, Young Women Christian Associates (YWCA) and World Vision have established further one-stop centers and drop-in centers. NGOs provide social services, counseling to victims (e.g. Lifeline Zambia, 24 hrs toll free telephone counseling service).[29] Further services are provided by World Vision, Women and Law in Southern Africa, Zambia Center for Communication Programme. The Project 'STOP GBV Programme: GBV Survivor Services, Access to Justice ended some years ago. A UN Joint Programme on Gender Based Violence, 2012-2016 established an Anti-Gender Based Violence Task Forces in five provinces and at five district levels. It opened village-led one stop shops, trained GBV response groups at the village level, trained community-based care providers in psychosocial care, and established 60 community help desks in districts.

One Stop Centers offer medical services qualified health professionals, psycho-social counseling, legal services, information dissemination, and shelter. In the Makaba Dam area, GBV organizations exist, including the Department of Social Welfare. Cases can be reported to the local Victim Support Unit (VSU) at the police station in Namwala, and can be treated at the Namwala District Hospital. There is further a District Child Protection Committee that works for children, women and the promotion of Human Rights. The committee is composed of district representatives from various departments.

[25] Z. Ngonga, Factors contributing to physical Gender Based Violence reported at Ndola Central Hospital, Ndola, Zambia: A case control study, In" Medical Journal of Zambia, Vol. 43.3., p. 145-151, 2016.
[26] ODI: Baseline Study, Stamping Out and Preventing Gender Based Violence (STOP GBV) in Zambia, March 2015, p. viii.
[27] Ditto, p. x
[28] Ditto
[29] Chidoori Rumbidzai, 2011, p. 32

Respondents further stated that more sensitization on this issue was required. Especially in view of public works project, respondents fear that contractors can lure little girls and married women, offering payment for their services.

4.3.4 Cultural Environment

For the development of this ESMP, stakeholders were consulted, including the members of the Makaba DMC, dam users and district stakeholders (District Commissioner, representatives from Social Welfare Department, Arts and Culture Department, Forestry, Agriculture). Consultations were held in regards to the upstream and downstream communities (3 upstream and 5 downstream) around the dam.

Stakeholders claimed that the previous public works on the dam have not impacted the communities' cultural practices or heritage, and that there are further no significant or historical features or graveyards in the area. No potential cultural environment and cultural heritage impacts are therefore expected as impact of the proposed works and the operational phase.

In case chance finds occur during construction activities, chance find procedures are attached to this ESMP (see Appendix B).

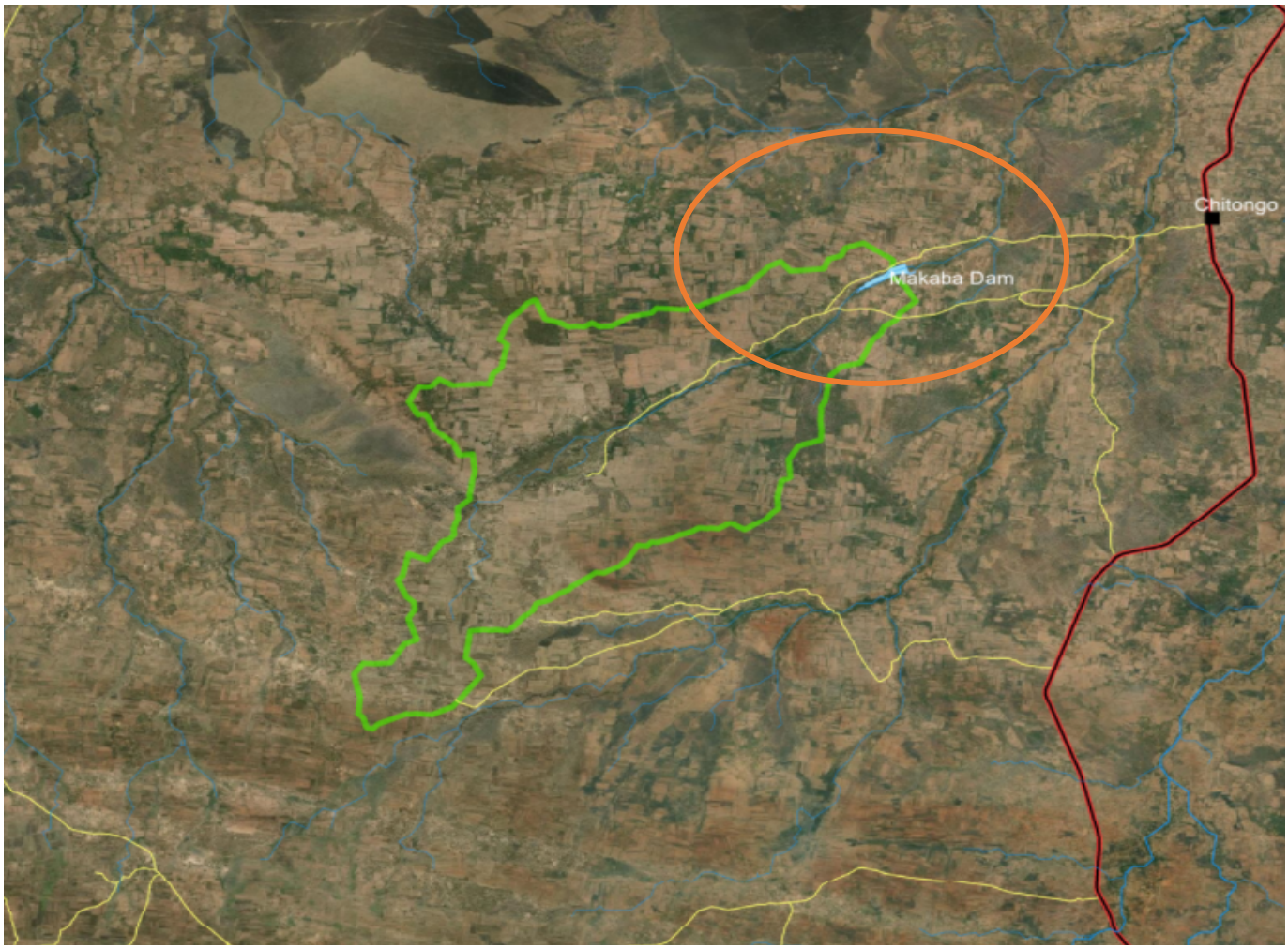


Figure 15: Schematic consultation coverage within 5km of the dam wall

5 Sub-Project Characteristics

5.1 Dam Characteristics

Makaba Dam is an earthfill dam, which was constructed by the Ministry of Agriculture in 2000 and was rehabilitated in 2008. Further works were carried out in 2017 by the WRDP. According to the design report, the dam has spilled annually, even during the drought season. There has been progressive damage to the spillway return drop structures, return channel and training walls from passing successive floods as well as damage to the main embankment from both livestock and runoff - particularly at the downstream face. Evidence of several “boils” in the seepage areas immediately downstream of the toe are further cause for concern.

The dam is located on a seasonal river, which is a tributary of the Munyeke River, draining into the Kafue Flats. The main purpose of the dam is to provide water for year-round irrigation of crops and water for cattle, as well as for aquaculture. The dam location is shown in Figure 16. The main dam characteristics are shown in Table 10.

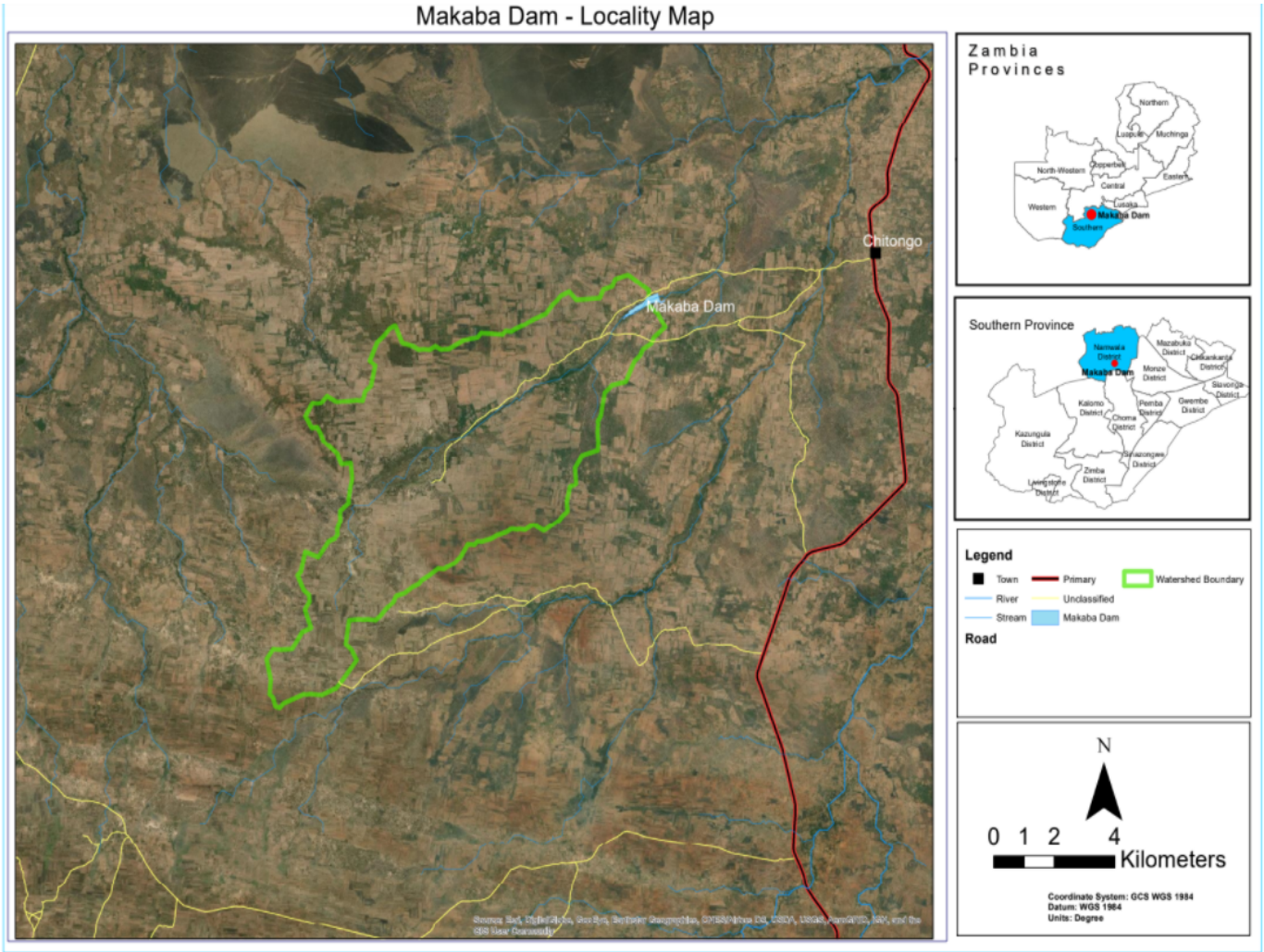


Figure 16: Google map showing location of Makaba Dam, UNOPS 2020

Table 9: Main Characteristics of Makaba Dam

Dam Catchment Data

Catchment area[30]:

Source Document	Year	km^2	Method of calculation
COWI - Aurecon	2018	66.72	Survey works in 2018
Ministry of Agriculture	2020	66.72	Taken from COWI - Aurecon submission
UNOPS	2020	68.78	STRM 3D DEM (NASA) and ArcGIS

MAP, MAR, Inflow

- The Mean Annual Precipitation - MAP - for this area is 745 mm.
- The Mean Annual Runoff - MAR - for the area is 65 mm
- The MAR used is in accordance with the Zambia National Water Resources Master Plan. Also, taken into consideration is work done by Imagen Hydrological Consultants on the Luezi Dam near Zimba in 2014 calculated a MAR of 70mm per year runoff.

Based on the above data, the average annual inflow at the dam site is 68,780,000*0.065 = **4,470,700m^3**.

Dam Capacity

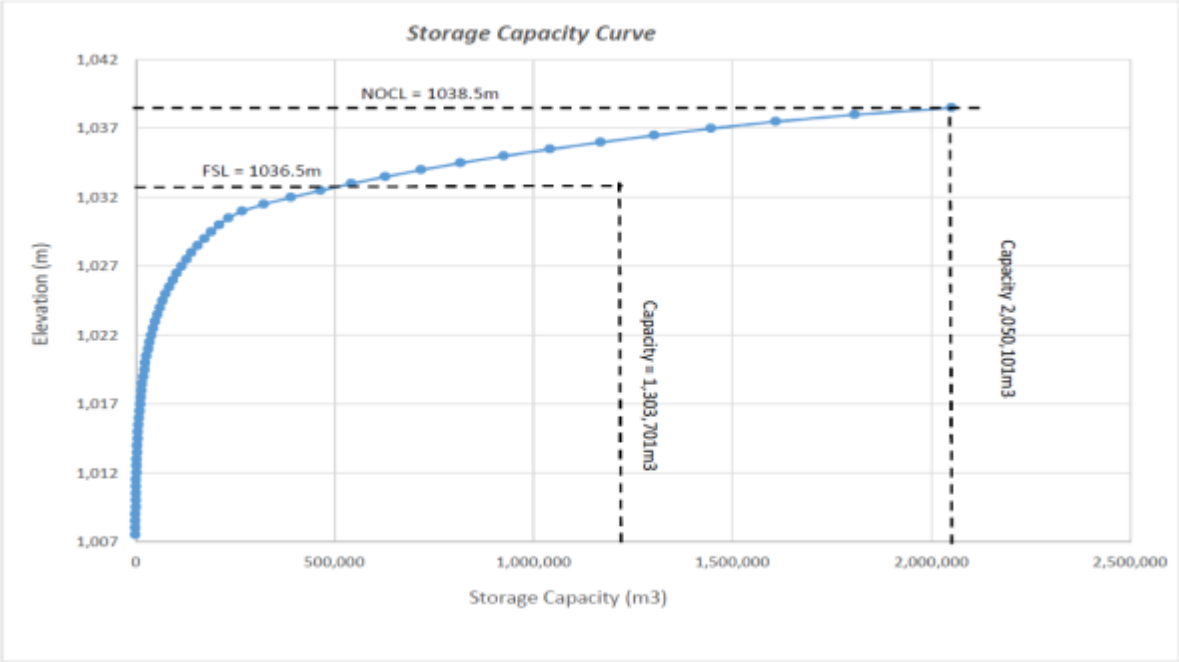
Source Document	Year	m^3	Method of calculation
Ministry of M E & WD	2013	1,000,000	Desktop study not verified
COWI - Aurecon	2018	1,303,701	Full basin survey - topographic, UAV and bathymetric

Assuming a 70mm MAR the average annual inflow:	**4,447,700 m^3**
Current estimated capacity of the dam:	**1,303,701 m^3**

The site has been developed to only **29.16%** of its capacity. This is **3.43** times the current dam capacity.

The Depth - Capacity Curve for the dam as generated from the 2018 COWI survey is given below

[30] UNOPS Design report, Makaba Dam Remedial Design, 2020



Sedimentation

The catchment size is **68.78km^2** and assuming a sedimentation yield of 5000ppm (since it is a poorly conserved catchment) with an assumed 100% trap efficiency of the dam, the dam will lose approximately 13 400m^3 of water per year. This equates to 1% of its capacity lost on an annual basis.

Geotechnical Investigations: The purpose of the limited geotechnical investigations was to primarily assess the materials used in the construction of the embankment and to assess the quality or consistency of the compaction in the embankment, and additionally to assess borrow materials for possible remedial works.

Samples were taken from the embankment at the location of the Standard Penetration Test (SPT) and can be reviewed under item 2.3_Geotechnical investigations results in the review folder. The relevant samples are: 1, 2, 6, 7 and 8. Boreholes 1 and 2 were retested as the method was found to be incorrect.

The SPT results indicate that the compaction is generally consistent, however the foundation bearing pressures were noticeably less than that of the placed material.

Regarding the Atterberg Limits Result, all the materials sampled were CL, i.e. sandy silts. As a rapid guide in assessing the suitability of soils for shoulder material reference is made to the Plasticity Product (PP). If the PP is above 600, it is considered suitable as a core material. Shoulder material is considered good between 400 and 200. Lower than 200 is either very coarse, but still usable depending on the grading. The results below indicate that the samples are predominantly silts and not ideal material.

Sample	Plasticity Index (PI)	% passing the 75 µ	Soil Classification	Plasticity Product (PP)
1*	18%	8%	CL	144

2*	17%	13%	CL	221
6	18%	21%	CL	378
7	15%	6%	CL	90
8	12%	9%	CL	108

**Retests*

From observation, the embankment is clearly made up of this material, which although not ideal has not exhibited any signs of slope failure other than in the areas of toe seepage and livestock activity. Around these, potential water holes have created cut back on the embankment toe.

Embankment Crest and Slopes

There are no original design drawings available for the Makaba Dam, however, it is assumed that the upstream and downstream slopes were 3:1 on the upstream and 2.5:1 on the downstream, with a crest width of 4m.
The current crest width is generally less than 3.5m, with a few sections where it reaches 4m.

Checks carried out from the cross sections taken from the recently completed survey of the embankment show the portion of the upstream slope above the current FSL and show that the downstream slope is generally in compliance with the above slopes. There is a change in the crest definition and level towards the spillway drop, reducing the effective freeboard. The freeboard varies from 1.72m to 0.96m.

The embankment is not in good condition. While it has a reasonably uniform slope throughout, the left-hand end of the embankment is steeper than the central - main body – section. It then appears to steepen up again slightly as it nears the bend at the right hand end of the embankment, where it turns into the spillway training wall along the discharge channel.

General condition of embankment crest

Seepage at and downstream of toe

Main Embankment – Crest, Upstream and Downstream Faces: The overall condition of the main embankment - and to a large extent the whole structure- is relatively poor and in need of remedial works. Seepage at the downstream toe and unrestricted livestock access -as evidenced by the footpaths along the length of the downstream embankment face - is exacerbating the problem.

Embankment overview

Crest: The crest is generally in an average condition and with a fairly uniform width of 3.5m+ (with a few sections that may make it out to 4m). Both upstream and downstream crest edges show varying degrees of breakaway and the beginning of gullying. It appears that the embankment crest has had more material placed on it at some stage as the last portion of the upstream and downstream faces seems to steepen up considerably to the crest.

Typical condition of main embankment crest

Downstream crest showing breakaway and gully formation

There is minimal rutting from the pedestrian and bicycle traffic over the embankment from the left bank. However, there is a degree of erosion that is related to these paths leading down to the concrete spillway sill at the right hand end of the embankment. Results of the recent topographical survey carried out indicate that this is a minor issue, but there is need to correct the profile.

Upstream Face**:** The upstream face appears to be in fair condition with no trees or shrubs growing and no evidence of any significant ant workings or animal burrows. The grass cover is good, despite some livestock activity causing rutting and subsequent gulley erosion due to the fact that there is no stone pitching or riprap in place. The overall slope appears to be uniform (2.5:1 if not more). This needs to be checked against cross section profile take from the recent survey done, as well as the survey by COWI in 2018 (it includes a bathymetric component – which has picked up the front face slope beneath the Full Supply Level, which the current survey does not). As the dam has been largely full, even with the full irrigation draw off, it is highly unlikely that a rapid draw down situation will occur from normal usage and the current slope appears to be adequate in terms of stability.

The front face grassing is possibly inadequate for the fetch and the fact the dam seems to be full for most of the year. There is also some "beaching" below the current waterline, but it is not extensive. There are a few small trees growing on the front face .

Front face condition

Downstream Face: The downstream face is not in good condition although it does have a reasonably uniform slope throughout. The left-hand end of the embankment is steeper than the central - main body - section and then it appears to steepen up again slightly as it nears the bend at the right hand end of the embankment where it turns into the spillway training wall along the discharge channel. The main body of embankment has a relatively flat slope of between 2:25 and 2.5:1. The top section of the face steepens up close to the intersection with the crest – possibly due to more material being added to the crest at some stage. There is no seepage exiting the embankment above the toe line indicating the phreatic surface is totally within the embankment, which is positive in terms of embankment stability. There are many livestock (mainly cattle) footpaths criss-crossing the downstream face, all adding to the erosion that has taken place. In particular, the trampling in the seepage areas at the downstream toe has caused sections of the embankment to break away and the embankment to cut back.

Downstream face of embankment - gullying and livestock footpaths

Downstream face of embankment - cut back of toe, trees and gullying

There are a few small trees and shrubs growing on the downstream face. There is a lot of evidence of termite workings on the back face, mainly higher up the embankment. Attempts by the DMC to seal these off with cement/concrete are evident but these will be futile as they do not resolve the problem of the subterranean water pathways caused by the tunnels.

Termite workings on downstream face near crest

Termite workings partially blocked with cement

Downstream Toe Drains/Sub-Surface Drains: There was no obvious evidence of toe drains leading down to the rock toe in the low spot /old river line from either flank of the embankment. However, the members of the local DMC assured that toe drains were constructed when the embankment was first constructed in 2000 and that they have since been completely silted over.

Further, the committee members asserted that the drains were fitted with filter stone and slotted pipes to take the seepage water down to the rock toe – which is still visible. At least two "boils" are evident in the seepage spots near the rock toe, which could be seepage water collected by the now covered drains surfacing. This would mean the internal drainage system is working correctly and the reinstatement of toe drains linked to the blanket filter would direct this seepage away from the embankment and clear up the current messy seepage spots along the toe. Alternatively, these "boils" could be evidence of water passing beneath the embankment and key trench and surfacing,

which means that the uplift pressures in these regions are high and could have serious stability ramifications for the embankment.

"Boil" evident in seepage near rock toe

No evidence of toe drains on right flank

No evidence of toe drain on left flank

Downstream Rock Toe: There is some evidence that some kind of rock toe was placed during construction. However, it appears to have been minimal in size and effectively non-existent. There are no original construction drawings.

Evidence of minimal rock toe

Seepage wet spot near rock toe location

Downstream Seepage: There is seepage evident at several places along the length of the embankment toe as well as in the low spots on either side of the original river line downstream of the toe. There are a few “boils” present and observable flow from the spots just to the left of the rock toe. While the standing water in the stream is only a short distance from the toe, the whole area between the toe and this point is very flat and wet and spongy.

Seepage at toe and downstream to the river line

Seepage at rock toe and right flank of river

Seepage at Toe vs. Seepage Downstream of Toe: Seepage appearing at the toe is considered to be primarily water passing through the embankment's internal drainage system and daylighting at these points - though on the left bank there may also be an element of water passing through or under the key trench. This can be seen at the large mushy area and the through the fact that the embankment is cut back by being trampled by cattle.

Aerial view of seepage along toe of embankment

There is not excessive seepage flow, and this was observed to be clear even with evidence of “boils” – the clear flow indicates that there were no entrained particles and the possibility of piping problems in or beneath the embankment. Seepage appearing at the wet spots on either flank of the river line downstream is considered to be water passing beneath the embankment and key trench.

Spillway

Service Spillway: Sill Section and Return Channel: The service spillway is a 40m wide concrete sill located at the far right-hand end of the main embankment. The effective spillway width is badly compromised due to the ground level being higher than the spillway sill on approximately 50% of the inlet channel. The sill is only marginally higher than the natural ground level in the section of the return channel down to the first concrete drop structure. There are no abutments to the spillway sill and no means of assessing whether it is capable of withstanding undercutting should the first drop structure be compromised and the gully currently immediately downstream cuts its way back to the spillway.

Service spillway and discharge channel – badly compromised effective width

Secondary Spillway: There is no secondary spillway and no feasible place to construct one.

Embankment at Service Spillway Concrete Sill: The 90-degree bend in the embankment leading into the spillway discharge channel training wall is part of the river crossing point for the local population on the right bank of the dam. The heavy foot and bicycle traffic at this point has badly eroded the front face of the embankment. Although the concrete spillway sill is approximately 40m wide, the distance to the shore on the other bank is about 50m at HFL due to the lack of any spillway abutment wall.

Embankment end at spillway sill showing erosion damage

This is not an ideal situation with the potential for serious wash damage during flooding.

Spillway erosion

Spillway Return Channel Training Wall: The spillway discharge channel training wall running from the bend - at the spillway sill – to beyond the second concrete drop structure in the channel has a very narrow crest of approximately 2m and steep upstream and downstream slopes. Beyond this, the slopes flatten out considerably and the crest widens but the gullying in the channel has severely washed and undercut the wall – almost to the point of breakthrough - for a considerable distance towards the third drop structure – which itself has been completely washed away.

Spillway return channel showing drop structures, gullying and training wall washaway

There is evidence of two previous training wall breakthroughs, and separate new return channels cut to the river. These have since been substantively repaired. A third breakthrough just downstream of drop structure 2 has recently been prevented by the local community with the use of sandbags. A similar intervention with sandbags has prevented a bypassing of the second drop structure connection to the training wall.

This is of a highly temporary nature and the serious undercutting of the wall beyond the sandbag repair is badly in need of some form of temporary repair to see this wall through the coming rains. This problem is better understood by studying the photo in the Figure below.

Temporary protection works needed for getting through the 2020/2021 rains

Drop Structures: There were originally three drop structures constructed down the length of the spillway return channel. Their design and operation in the prevailing ground conditions appears to be completely inadequate for the task at hand - as evidenced by the fact that the third drop structure has been completely washed away and the scour is such that there is no possibility of reinstating it in its original position. Similarly, both, drop structures 1 and 2, are being undercut by the gullying that is working its way steadily back up the channel towards the main spill section.

Erosion at drop structure 1

Erosion at drop structure 2

Total washaway of drop structure 3

Flood Design

A 1:100 year flood of 81.2 m^3/s, with a Safety Evaluation Flood (SEF) of 94.7 m^3/s was used in the original design. It is not known what method was used in obtaining the design flood in the initial design.

The adopted Design Criteria for this project is based on the Mitchell Formulae used extensively in Zimbabwe for the PMF estimation. The return periods have been checked in comparison with results obtained from the VKE and Pitman.

Based on the design criteria and current surveys, the summary of the spillway details is as follows:

Catchment Area.	69 km2
Max Probable Flood	759 m3/s
100 year Flood Estimate	342 m3/s
Fetch	1.25 km
Dry Freeboard	0.600 m
Service Spillway Width	39.000 m
Current Crest Level	1037.940 m
Spillway Level	1036.980 m
Coefficient of Discharge	1.8
Current Freeboard	0.960 m
Estimated Raising Required	**2.500 m**
Est. Freeboard Required	3.460 m
Revised Crest Level	1040.440 m
Riverbed Level	1033.0m
Height of Dam	**7.0m / max 4m depth of water**

The design flood adopted requires an increase in the current freeboard of **2.5m**

Outlets: There are no pipe outlets through the embankment in the current configuration of the Makaba Dam. Irrigation requirements are catered for by means of two siphons in the form of 150 mm concrete encased steel pipes set at the level of the dry freeboard and feeding into concrete lined channels.

5.2 Overall Legacy Issues of the Dam

The legacy issues are illustrated below and mitigation measures are shown in Chapter 7 Section 7.2.
.

5.2.1 Structural risks

Spillway risks:

- Erosion and structural failure
- The current spillway sill not defined at FSL and is eroding
- The approach channel issues and restricted flows
- Spillway design capacity

Return channel drop structures and training wall risks:

- The return channel erosion and gullying
- Shallow undercut of the structure
- No stepping and leveling

Embankment and slope stability risks:
- Upstream and downstream slope livestock damage
- No stone pitching
- Low downstream wall
- No adequate chimney drain for the entire length of the embankment

Rock toe risks: No working rock toe and concrete toe drain

The following pictures further illustrate the above conditions:

Figure 17: Drop structure condition

Figure 18: Front face condition requiring slope works

Figure 19: Seepage wet spot near rock toe location

Figure 20: General condition of embankment crest

Figure 21: Seepage at and downstream of toe and livestock paths

Figure 22: Erosion at Drop Structure 1

Figure 23: Total washaway of drop structure 3

5.2.2 Environmental, Health and Safety Risks

Construction phase

Demobilization and Restoration Plan absence risks:

- Unrehabilitated contractor sites
- Safety and health hazards for the community

Rehabilitation of disturbed works areas risks:

- Erosion and sedimentation

Rehabilitation of community roads risks:

- Loss of community access
- Loss of biodiversity

Rehabilitation of borrow pits risks:

- Erosion and sedimentation
- Entrapment risk to wild animals
- Failure to rehabilitate causing increased malaria risks and increased risk of children drowning or injury.

Community health and safety risks:

- Access point drowning risks
- Drinking water from the dam, untreated may cause water borne diseases
- General serious or fatal incidents/drowning

Access across the river risks;

- Lack of a bridge/crossing with increased risk of community injury and drowning

Operation phase

Community health and safety risks:

- Injury or illness caused by lack of knowledge of dam risks.
- Lack of capacity to respond effectively to emergencies related to the dam
- Lack of knowledge about actions to take in emergencies
- Serious or fatal incidents/drowning.
- Increased prevalence of water borne diseases
- Drinking water from the dam, untreated may cause water borne diseases

The following pictures further illustrate the above conditions:

Figure 24: Community Paths Leading to the Dam Spillway/ Embankment Access Route

Figure 25: Borrow pit next to the Basin /Upstream

Figure 26: Pedestrian, livestock and ox cart road flooded at spillway going towards embankment (Ox cart tracks present)

Figure 27: Borrow pit used as animal watering when it ponds

Figure 28: Map of the existing borrow pit at the edge of the basin

5.2.3 Social risks

Community development risks

- Food security – inadequate fish training for communities
- Inadequate water supply infrastructure for irrigation
- Lack of capacity/training to benefit fully from irrigation water supply
- Inadequate pest management
- Broken canal crossing over the eroded spillway return channel

Figure 29: Broken canal over channel due to expanding eroded return channel- temporarily fixed using logs

5.3 Potential Communities Affected by Works

The rehabilitation of the dam will benefit at least 3 villages upstream and 5 villages downstream, with approximately 600 inhabitants per village, administered by 8 headmen. Rehabilitation works will increase the amount of water in the dam and will therefore provide socio-economic benefits through water use activities.

The communities engaged during consultations expressed their desire to engage in increased irrigation activities and resulting livelihood improvements. The dam was constructed with canals, which are being used. Canal elongation, however, will increase water availability for the communities. The works will therefore have significant socio-economic benefits as it will increase water in the dam that may be used for irrigation. This can include irrigation water supply for upstream and downstream communities.

Furthermore, the rehabilitation activities will create temporary local employment for the duration of the construction and will therefore benefit both, women and men. Contractors will be required to recruit local workers. The total workforce will be approximately 50 people. 15 of these are likely to be externally recruited, including an engineer, a foreman, site workers, a storekeeper, and the ones that will be handling heavy machinery and equipment as it is not expected that specialized or skilled workers will be available in the Namwala communities. Approximately 35 workers will be recruited from the Namwala communities. Their tasks will comprise concrete works, work on the embankment, and any other manual tasks. Construction works will approximately take 6 months.

Since the sub-project activities are temporary in size and the amount of externally recruited workers will be small, there is no significant labor influx expected, including impacts on local resources and services. Similarly, risk of exacerbation of local existing conflicts is low. Also, the potential that a workforce interferes with local communities from different political or factional backgrounds is small.

For the 15 external workers, the contractor will need to have a site office, for meetings and for the storage of materials. However, out of the 15 people, only the foremen, site men and storekeepers, and those handling heavy machinery and equipment are likely to be at the site for the entire course of construction. Hence, between 7 and 8 external workers will be at the site permanently. Workers will be transported to the construction site and likely remain there for the construction period. Staff like the engineer will visit the project site but will not be there the entire time.

The contractor will have to build a campsite for the 12-15 workers, who are not transported to the site on a daily basis and who are not locally recruited, as well as for storage or materials; and will have to provide convenience facilities for the whole workforce. The community and DMC suggested that the former campsite area, which is on the left side of the dam can be re-used for the proposed works. This is at least 50m from the dam and before the school. The new campsite will be located at least 500m from the school to take into consideration social risks and impacts of the labor force on school children.

5.4 Dam Safety

The dam safety reports for Makaba Dam include the Emergency Preparedness Plan (EPP) and the Operation and Maintenance document which will be shared with stakeholders.

The primary goals of an EPP are as follows:
:

- To ensure that arrangements are in place for an effective response at the scene and, as appropriate, at District, Provincial and National levels to a dam failure emergency;
- To ensure that, for reasonably foreseeable incidents, inundation consequences are minor;
- That potential emergency scenarios are identified and early detection measures are in place to identify the potential failure;
- To take practical measures that mitigate any consequences for human life, health, property, infrastructure and the environment.

It is incumbent on the dam owner to have an EPP in place and to ensure that the dam is safety evaluated, as prescribed, and that site monitoring and documentation are kept up to date by the operator. It is important that there is adequate training of the operator(s) to identify early signs of failure and the correct notification procedures. The emergency preparedness and responses should be established in advance. The plan should be regularly exercised, to make all parties aware of their roles and responsibilities as well as to identify possible flaws in the plans. A notification flowchart is essential for any EPP and the contacts in particular should be updated regularly.

Communication systems must be robust and have back up alternatives - both in terms of contacts and systems. Use of appropriate local languages will be ensured for ease of understanding by local community members. The notification flow chart has been developed in case of an emergency. The DMC and disaster management authorities have a key role in the plan. Training and sensitization of the parties involved will be undertaken prior and during construction works. The inundation maps, affected infrastructure in case of dam break, training plan, reviews and mitigation measures are included in the report. Documentation accompanying the flowcharts includes the following:

- Owners details
- DMC members
- Disaster Management Authorities Chain
- Dam details and documentation
- Inundation mapping
- Preparedness
- Affected infrastructure

The operation and maintenance planning includes the following:

- Components of the infrastructure that require operation and maintenance, for example, replacement of dam components, flow monitoring, monitoring termite invasion, inspecting for leakage along the dam wall.
- A schedule and procedure for maintenance. These include tasks such as inspections of the components, infrastructure and dam wall, identification of parts requiring replacement, and costing.
- Early warning systems for major maintenance.
- Other managerial, social, institutional and financial tasks such as setting user fees, collecting and accounting for the same.
- Required capacity building.

6 Proposed Remedial Works

6.1 Embankment Remedial Design

6.1.1 Slope Stability

As this dam stores approximately 4m of water above riverbed level at the Full Supply Level, no stability issues are to be expected (see ICOLD Manual on Small Dam Design). In case stability issues do arise, they can be addressed during downstream raising by easing the downstream slope to 1:2.5. Furthermore, the inclusion of adequate filters, a more substantial rock toe and placing suitable shoulder material may be undertaken.

Current Upstream slope approximately	1:2.5
Current Downstream slope approximately	1:2.0

The downstream slope will be eased from 1:2.0 to 1: 2.5 through a 2.5m raising. There is no indication of a phreatic surface daylighting on the downstream slope of the current embankment, but UNOPS still proposes to incorporate a 500mm wide chimney drain for the entire length of the embankment.

This chimney will start at the current toe line and follow up the existing downstream slope (once it has been properly trimmed) - to a height of half of the full supply level (FSL) in the deepest section of the embankment and to the FSL on the shoulders - effectively along the interface of the new placement against the existing embankment (Figure 31).

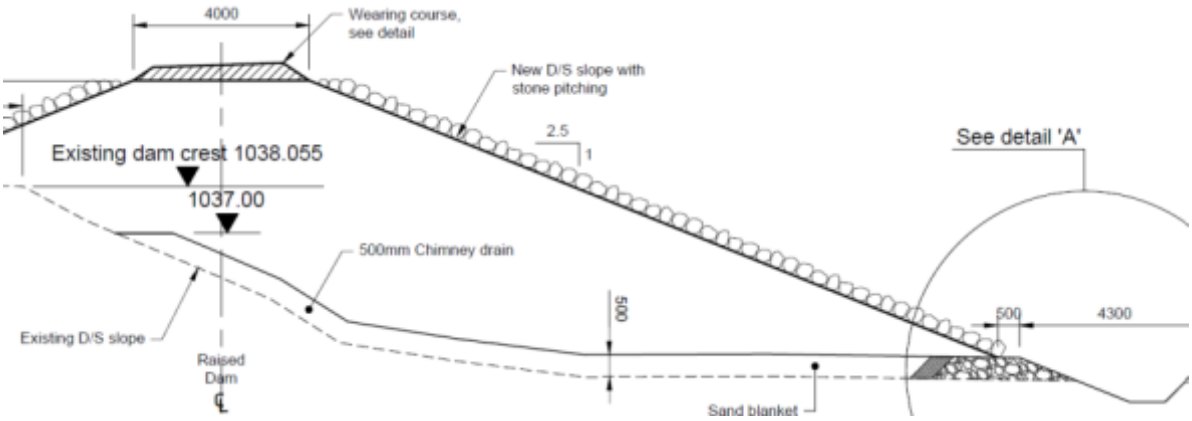


Figure 30: Raising cross section showing chimney filter location

Above the rock toe level, 1.5m x 0.5m finger drain offtakes at 20m centres on either side will lead off the base of the chimney to reverse filters into a toe drain constructed at the new toe. The raising will have the effect of moving the centre line of the current embankment downstream. It is proposed to remove the top 1.5m of the embankment and use it in the construction of the expanded embankment. The upstream slope will be repaired above the water line and stone pitching will be placed to cover the complete surface - mainly to prevent future livestock damage.

6.1.2 Rock Toe

The original downstream rock toe was small and has been covered up by siltation caused by the spillway training wall washaway and eroding of a new return channel to the river just downstream of the

embankment toe.

A more extensive rock toe will be placed in this area as part of the embankment raising exercise, extending at least 2.5 m vertically up the embankment face and incorporating a reverse filter on its upstream side to cater for any seepage passing through the embankment at this point.

In addition to controlling riverbed section seepages, the rock toe will provide additional weight against the embankment at its deepest section and thereby increase the overall stability (Figure 32).

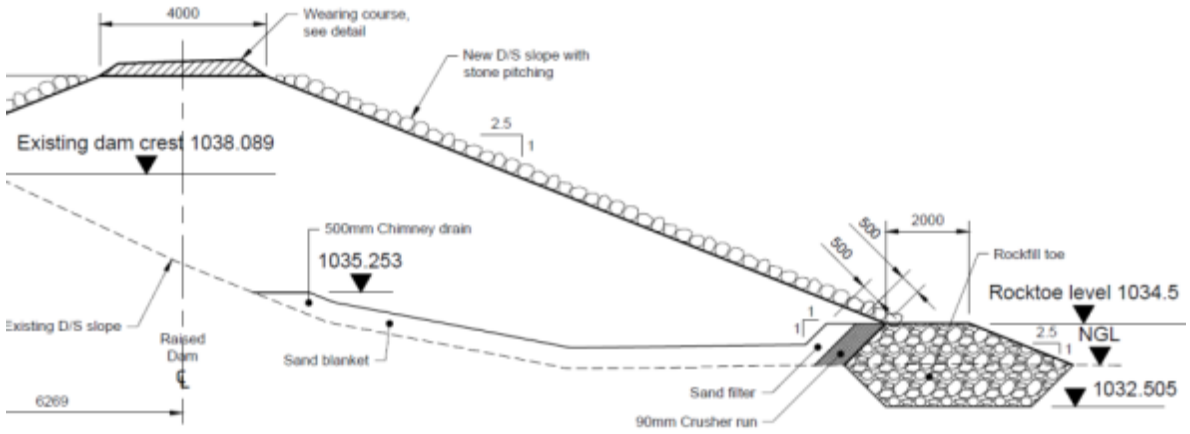


Figure 31: Typical Section of Rock Toe and Filter in the Riverbed Section

Concrete/stone pitched open toe drain**:** The toe drain will collect outflow from blanket filters and runoff from the embankment slope. This should be an open concrete lined or stone pitched drain that can be regularly cleaned out if necessary as the open earth drains that are filled with stone invariably clog up with silt and become ineffective. The upstream slope of the drain should match that of the downstream embankment slope - in this case 2.5:1 - and the downstream slope can be cut at 1:1 (Figure 33).

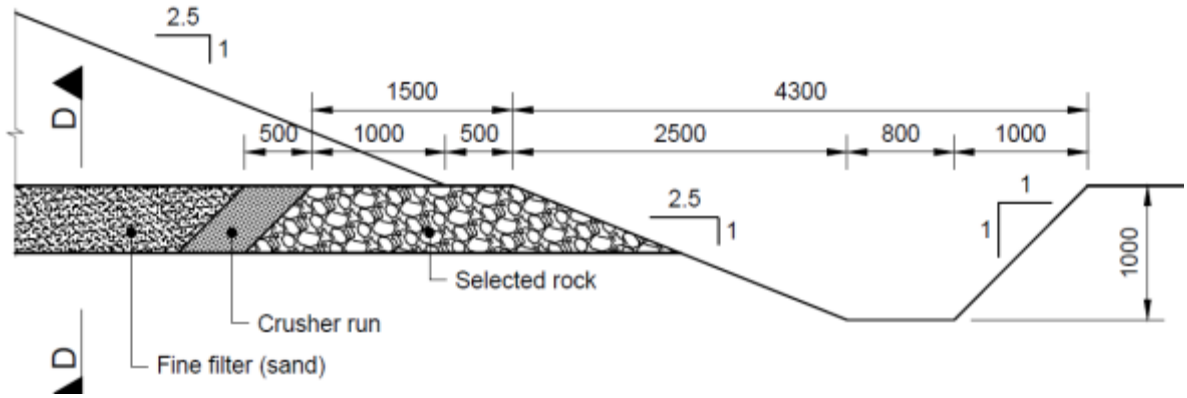


Figure 32: Typical Section of Toe Drain and Embankment Internal Filter

The surface toe drains on either side will end at the start of the rock toe and be diverted along the edges of the rock toe to discharge into the river bed. Both of these discharge drains will be fitted with fixed V notches to enable the measurement of the flow in the drains. A good alternative is the use of a suitable concrete filled membrane roll - such as “Concrete Canvas” which can be rolled out along the earth channel profile and simply watered to activate the concrete mixture. The cost of this should be compared with the

cost of bringing in suitable stone for a stone pitched channel or the concrete for a concrete lined channel.

Slope protection: To protect both upstream and downstream slopes from livestock damage, stone pitching both faces to preserve the slopes is proposed, as it is more successfully than any fencing (especially as this is a communal area).

6.2 Service Spillway, Drop Structures and Training Wall

6.2.1 Spillway

The current spillway sill will be redefined at FSL using a gabion basket structure as previously illustrated with gabion abutments, with wing walls and cut off walls to the height of the newly raised embankment crest and constructed at both ends of the new gabion reinforced spill section. The downstream shift of the raised embankment centerline still allows for the spillway section to be upgraded in its current location and have abutments with wing walls and cut off walls installed at each end.

The approach channel to the spill section will need to be excavated out across a width wider than the spillway itself and extending upstream from the spillway at least 100m. This is to allow for unrestricted flow over the full width of the spillway so it can operate at its design capacity. Spillway works will enable easy access over the infrastructure.

6.2.2 Return Channel Drop Structures

As previously stated, the return channel will be controlled with 3 gabion drop structure bolster lines at 1m vertical intervals, back down to the riverbed level (Figure 34).

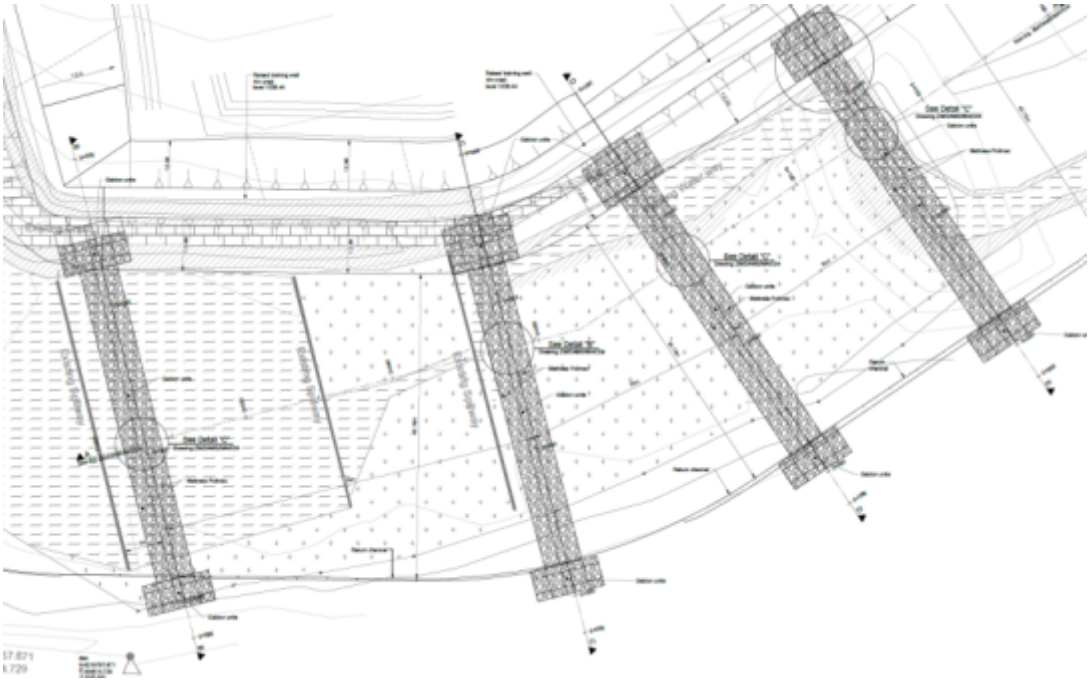


Figure 33: Spillway return channel drop structure design

Each 1m drop on the downstream side of the gabion structure is protected with a 2m wide Reno Mattress on either side of the gabion bolster line to reduce the shallow undercut of the structure. The crest of the next drop structure is at the same level as the upstream drop. The channel will be stepped and levelled

across its width between each drop and suitable material will be used for the embankment raising or the training wall remedial works. The critical point of each structure will be its connection with the training wall, as this is where the gullying may occur. A 2m gabion mattress will run up the entire embankment, both upstream and downstream of the head walls, and will be tied into the head wall and link into the mattresses.

6.2.3 Return Channel and Training Wall

The existing spillway return channel training wall will be replaced with 3.0m crested earthfill embankment with 1:2.0 slopes. After each drop structure headwall the crest level will reduce by 1m in keeping with the drops. In some places the return channel will need to be widened to the full width of the spillway. The widening will be from the right bank natural ground and cut to the same slope as the training wall embankment (1:2.0); and will be stepped in a similar way as to the training wall with a bench up to natural ground level from the reduced crest level at each section. Any gullies remaining after each step down and low spots will be backfilled with rock and levelled to provide an even surface for the water to flow over.

6.3 Outlets

There are no pipe outlets through the embankment in the current configuration of the Makaba Dam. Irrigation requirements are catered for by means of two siphons in the form of 150 mm concrete encased steel pipes set at the level of the dry freeboard and feeding into concrete lined channels. The raising of the embankment will present the opportunity to include suitably designed, more robust siphon arrangements. This is beyond the scope of the current works, but should be included as part of the construction so the pipes can pass through the top section of the embankment - within the dry freeboard zone - and not over the crest and disrupt pedestrian and bicycle access.

6.4 Construction Materials and Amenities

Construction materials required for the remedial works as detailed above are as follows

- Sand and Stone for minor concrete works - Munyeke River - 22 km.
- Stone for gabion basket filling - Munyeke River - 22km.
- Rock for riprap and downstream toe - Munyeke River - 22km.
- Common fill for embankment raising and spillway training wall.
  Wearing coarse gravel for roadway on crest - local ZNS gravel pits.

The contractor and the engineer will work together to determine the exact locations of these materials. There are no licensed suppliers; therefore, permits will be obtained once the sites are agreed on. Accompanying method statements with environmental protection measures will be prepared by the contractor. The environmental and social mitigation measures detailed in the ESMP table will also apply during sourcing, extraction and decommissioning. The permits required include land acquisition agreements and ZEMA permits/ management plan.

Guidance on identification of sites will be as follows:

Sources of materials for construction will be identified by the contractor and approved by the engineer. Before finalizing on the use of the site, it will be the responsibility of the contractor to engage the DMC and the local community with a view to get consent from the local leadership and avoid land and other conflicts. Should the sources selected prove inadequate or unsuitable in any way, the contractor will be required to identify suitable alternative sources including additional borrow areas, and still execute the same channel of consultations to get clearance from the local leadership and the municipal council. The designation of certain areas as borrow areas does not imply that all the materials within that area are suitable for use in the dam embankment. The engineer's representative will indicate which materials from within the general borrow areas are to be used in the embankment and which are to be left unused.

Rockfill and Aggregate*:* The rock requirements for the dam are concrete aggregate, placed rockfill for the embankment slope protection and the downstream toe, rock pitching of the downstream and upstream slopes, gabion baskets infill, coarse filter zones in the embankment, and rock for masonry and for backfill where specified or ordered. All suitable rock obtained from excavations for the dam and appurtenant works will be used in the structures, and every effort must be made to save as much rock as possible for this purpose.

Concrete aggregates will be obtained from the Zambia Environmental Management Agency (ZEMA) approved quarry sites or from an approved commercial supplier identified within Namwala or Choma Districts or nearby, provided they are economical. In some cases the contractor will set up his own crushing and screening plant. However, the latter process may take longer to be approves by ZEMA, since this will require preparation of an Environmental Project Brief for the proposed activity at the proposed location. The contractor must arrange for petrographic testing and crushing value testing of the material he proposes to use, at his own cost, and must submit adequate proof that such material is not likely to lead to long-term deterioration of the concrete. The contractor must also ensure consistency in the quality, grading and properties of the material to be used as concrete aggregates. Further testing may be requested by the Engineer, in the event that the consistency is considered to be divergent from the original samples and will be to the cost of the contractor.

The rock sources for the dam have not been identified and will probably have to be obtained from the nearest commercial source or by commissioning local communities to collect suitable rock from suitable surrounding areas. In addition, the contractor should locate a suitable quarry site to open and possibly operate.

If the engineer considers that suitable rock from the required excavations, including overlying boulders, has been wasted by the contractor, he may order the contractor to make up such assessed losses with rock from any other source approved by the engineer's representative at the contractor's own expense.

Coarse filter material will be obtained either as a crusher-run product or by winning and screening, and if necessary washing, local deposits of gravely material.

Earthfill: Suitable material for use in the rolled earthfill of the dam has not been extensively located. No materials will be taken for any purpose from within 200 meters upstream or downstream of the dam centerline, nor within 50 meters of the flood embankment, except for those materials won from necessary excavations as directed by the engineer's representative.

Sand: Sand will be required for the concrete and masonry and as filters in the earth fill embankments. It should be noted that it will be necessary to blend pit sand with river sand for use in concrete and for masonry mortar. The contractor is expected to have an understanding of suitable deposit sites prior to tendering.

Overhaul of Materials: There is no provision for the payment of overhaul of earthfill, gabion rock infill, rockfill or of concrete coarse aggregates and crushed filter material, and tenderers will include the full price of bringing these materials to the works from those areas designated for use in these documents, or from such other sources as may be selected by the contractor.

Transportation of raw materials: This activity will be well defined once the sources of raw materials are known. When transporting sand, quarry, gravel over a long distance and passing through a settlement of some community, the transporter will be required to cover the material with a tarpaulin and will use a defined route from the source to the construction site.

The social amenities required by the contractor include:

Water supply: The contractor will provide temporary potable water storage facilities and connection to the existing local borehole that is within 500m of the dam without compromising community access to the water. Water from this well was tested (refer to water quality section 4.1.4). It is safe for drinking and can be used by the contractor and its staff. The hand pump borehole location is at the Makaba School shown on the land use map.

Campsite: A campsite for 12-15 external workers will be structurally constructed within the site off the access road after the school. The campsite will be located at least 500m from the school and 150m from the surface water body. The community will be involved in the siting.

The contractor will provide the following at the site:

- Washing and sanitation facilities- incl. VIP latrines to be constructed within the site for ca. 50 workers (at least 2 latrines, 2m x 3m per toilet with opposite/alternate access and a privacy screen, one for

men and one for women). Each toilet will have a hand wash basin.

- Cooking facility at the campsite- all the cooking activities will only be conducted at the designed facility. Waste management (non-hazardous waste)- collection from waste receptors within the site, and disposal at council designated site located in Namwala urban at Lat. -15.824462; Long. 26.506227. Waste types, quantities and frequency of disposal must be communicated to the council in writing before disposal commences.
- Waste management (hazardous waste)- collection within the site under stipulated conditions in the ESMP table. Remediate where necessary or dispose of as per regulations.
- Any hydrocarbon storage facility will require bunded walls according to the stipulated ESMP table requirements. Any recyclers and re-users of waste must be licensed and monitored according to ZEMA guidelines.
- Temporary accommodation facilities for his staff. The temporary facility will be made up of local building materials or tents and with a minimum spacing requirement of 4.5sqm living space per staff.
- Office facility, a minimum space of 3m x 3m internal dimensions complete with air conditioning, an office table, at least 2 chairs, a common sink, internet, power connection with at least 1 dedicated power point.
- Vehicle and machinery parking area.

Additionally, the contractor shall ensure to the extent possible that the camps constructed from materials that can easily be constructed and dismantled. Other than those listed above, supporting facilities such as drop-down toilets, generators set for energy production will be established. To ensure that the camps are kept small, the employees will be obtained from the local people who will be coming from their own homes. The sites for campsites have not been identified and the contractor will make his own arrangements for a suitable site for his camp, after engaging the relevant persons for that piece of land. The contractor is expected to indicate where they intend to set up their site camps. The contractor will ensure that the identification and subsequent operation of the camps meet local and international environmental and social safeguards.

Access roads: Access to Makaba Dam is by a 7 km gravel road off Choma- Namwala tarred road. The access road which is the current dam access road is shown on the Land use map.

Labour force: The total workforce will be approximately 50 people. 15 out of this amount are likely to be externally recruited, including an engineer, a foreman, specialised construction workers, a storekeeper, and the heavy machinery and equipment operators as it is not expected that specialized or skilled workers will be available in the Namwala communities. Approximately 35 workers will be recruited from the Namwala communities.

6.5 Construction Programme

Considering the Scope of Works and possible sources of materials as listed under Item 10 - Materials, the rehabilitation works will be completed within 6 months.

6.6 Drawings List Available to the Contractor

No.	Description	Drawing No.

1.	Embankment Layout	ZM/DAMS/NC/C01
2.	Embankment Cross Sections	ZM/DAMS/NC/C02
3.	Spillway Layout and Remedial Works	ZM/DAMS/NC/C03
4.	Drop Structure Details and Remedial Works	ZM/DAMS/NC/C04

7 New Remedial Works Risk and Impact Mitigation Plan

This section provides the following:; common construction works management plans, monitoring requirements and the rehabilitation management plan after the current proposed works are provided in this section. The contractor is expected to operationalize these plans with details of his/her method statement.

7.1 General Construction Works Management Plan

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure** (prevent, reduce, mitigate, and compensate)	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
Non Hazardous Waste Management						
Campsite **Construction activities**	Solid waste generation and releases into the environment Public health and safety hazards	• The contractor will screen the proposed campsite area and should prepare a waste management plan for the site preparation, construction, operation and decommissioning. This will be reviewed and approved by UNOPS. • The contractor will employ the waste management hierarchy in the management of waste at all the work site, including a) waste prevention, and b) waste reduction strategies, waste segregation with reuse and appropriate disposal methods. A record of waste generated and detailed waste transport method with disposal methods will be kept on site. The contractor is prohibited by law to burn or bury any type of waste. The waste handling procedures and PPE requirements will be detailed in the method statement/ plan.	Construction Phase Daily	• Properly designated waste collection and disposal points. • Training/ sensitization records for 100 % of staff • Waste disposal records and logs • 100% cleaned up sit	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 500/month
Hazardous Waste Management						
Construction activities **Vehicular operation**	Hazardous waste generation and releases into the environment	• The contractor will screen the proposed storage areas and prepare a plan for the site preparation, construction, operation and decommissioning, as part of a Site-Specific Hazardous Waste Management	Construction Phase Daily	• Properly designated waste storage, collection and disposal points • Temporary storage	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 600/month

Sanitary facilities	such as hydrocarbons and sewer Public health and safety hazards	Plan. This will be reviewed and approved by UNOPS. • The contractor will employ the waste management hierarchy in the management of waste at all the work site, including a) waste prevention, and b) waste reduction strategies, waste segregation with reuse and appropriate disposal methods. A record of waste generated and disposal methods will be kept on site. The contractor is prohibited by law to burn or bury any type of waste. The contractor will produce site specific waste management plans and conduct regular waste segregation sensitisation of workers. • The contractor will dispose of hazardous materials at the Council/ ZEMA approved disposal sites. All bulk hydrocarbon storage tanks must be contained in a concrete bund that can accommodate 110% of the total volume of the product that is stored in the tank, with a concrete floor and no drain outlet. Any rainwater collecting in the bunded area that does not evaporate within a short time must be pumped into drums for disposal through concrete-line mechanical oil separators and the oil recovered and temporarily stored in a waste oil collection tank or sealed drums. The fuel dispensing pumps must also stand in a concreted area, with drains to an oil interceptor. • The contractor will not wash vehicles in the sub-project area, to avoid contaminating the surface water with oil leakages from the vehicles.		areas for hazardous wastes concrete-lined and bunded • Treated contaminated sites, 100 % • Training/ sensitization records, 100% of workers • Waste disposal records and logs available • 100 % of sites are cleaned up • 100% of sites specific waste management plans exist		

Soil Management						
Excavation activities during Proposed road rehabilitation, material sources extraction, rehabilitation works	Excavation resulting in release of dust, gas and particulate emissions Public nuisance and health and safety risks Soil destabilization leading to erosion and land subsidence Road surface instabilities	• The contractor will prepare borrow pit method statements and management plans for each site to detail the operation of the site and compliance with the ESMP. • The contractor will limit excavations and clearing to necessary worksites. • The contractor will ensure that site installation, excavations and any other soil movement activity will not be done during the rainy season to avoid erosion of material and gully formation. • The contractor will methodologically conduct site assessments, selection, and operation of the sites as indicated below: A depth of utmost 2.5m will be excavated for borrow areas for safety reasons. The excavation slopes will be reduced to a stable slope and indicated in the method statements. • The contractor will create and maintain topsoil stockpiles. Topsoil depth ranges will be between 150 mm and 500 mm. The exact depth will be determined from the geotechnical site assessment. Topsoil will be stripped and stockpiled away from other materials. Topsoil will be only used for reclamation purposes when pit operation is complete. • The contractor will incorporate drainage construction and runoff control at sites. Overburden soil will be used as a perimeter berm to direct drainage on the site or stockpiled separately from topsoil. • The contractor will rehabilitate and restore sites after works. This will include rehabilitating disturbed work areas and	Construction Phase Daily	• Minimized land and soil disturbances at the work sites • Suppressed dust levels and soil movement / erosion • All sites are soil stabilized sites • Separate soil stockpiles to specification • Drainage and run off control • Site restoration, 90% for regeneration • Site Method Statements and management plans prepared	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ DMC	HSSE Officer Cost 1000/month

		restoring as close as possible to original contours. Restore topsoil from stockpiles. Replant with native plant seed mixes, and combined with natural revegetation. Overburden soil can be used for landscaping.				
Land Use and Aesthetics Management						
Infrastructure rehabilitation works, Disturbance of sites, campsite construction	Changes in aesthetics, scenic view, visual character and land use	• The contractor will maintain consistency with existing land-use features and designs.	Construction Phase Monthly	• Minimised aesthetic impacts • Rehabilitated and restored sites, 100% • Blending land-use	Contractor Engineer and HSSE Officer UNOPS/IDSP	HSSE Officer Cost
Surface and Groundwater Pollution Management						
Activities and Works around and on water bodies	Poor water quality Public health and safety risks	• The contractor will control siltation, minimise unchanneled runoff and soil erosion by constructing drainage channels. • The contractor will provide sanitary facilities in the form of 2 VIP toilets for the workers at the campsite (1 for females and 1 for males). These will be monitored and properly decommissioned by adding lime. • The contractor will inspect machinery and vehicles for spillages and leakages on a daily basis, before use. • The contractor will dispose of construction debris and any wooded debris in legally designated site at the council dumpsite. Disposal in the reservoir or water bodies will be prohibited. • The contractor will ensure that the location of the campsite will be at	Construction Phase Monthly Or as required in case of an emergency/ incident	• Refer to water quality results in the ESMP • Water quality results, monthly • The monitoring parameters will include biological, physical and chemical drinking water quality parameters. These will include parameters analysed in this ESMP: pH, conductivity (µg/cm), sulphates (mg/l), nitrates (as no3-n mg/l), total dissolved solids (mg/l), ammonia (as nh4-nmg/l), phosphates (mg/l), total	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 1000/month

		least 500m from the school and 150m from the water. The community will be involved in the siting. • The contractor will monitor water quality in the upstream basin and downstream by conducting initial water quality monitoring at commencement with monthly monitoring during construction. • The contractor will conduct drinking water quality testing and treatment of drinking water.		suspended solids (mg/l), chemical oxygen demand (as mg o2/l, chlorides (mg/l), turbidity (NTU), hydrocarbons (mg/l) additionally with total and fecal coliform tests. If hydrocarbon contamination is suspected, the test will be included. The testing will be done at certified/ approved laboratories after proper sampling methods. • Pollution control structures • Training records, 100% of workers trained • Inspections reports, weekly		
Air Quality and Noise Management						
Transportation, rehabilitation works at all worksites, campsite activities	Biomass burning impacts, dust from the roads and sites, noise from equipment	• The contractor will use auxiliary sites close to the dam to minimise haul distances and avoid worksites close to sensitive receptors such as households, clinics, schools etc… • Working hours to be limited to between 06:00 and 18:00. • The community will be sensitised on working sites and routes. Equipment noises below acceptable limits. • The contractor will continually water	Construction Phase Daily	• Complaints records • Inspection sheets • Receptor sites protection	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 500/month

		sites and limit soil movements during works by stone pitching sites or vegetation. However, care must be taken to ensure that water used for this activity does not deprive local communities or affect the dam water quantities				
Construction materials (sand, stone, rock, gravel)						
Extraction and transportation activities	Land degradation, falls, waterborne diseases due to collecting water, health and safety injuries during mining, non ZEMA regulated activities, soil erosion, biodiversity loss, traffic accidents, noise and air quality, child labour from unregulated sources	• The contractor will source materials from reliable, regulated sources with ZEMA approved operations or will conduct the mining themselves using the approved environmental and social mitigation measures using a detailed method statement prepared by the contractor. • The contractor will refer to the relevant management plans in the table; traffic, labour, air, noise, water, soil, land, health and safety. • The contractor will also refer to the relevant management plans discussed in Appendix J • The contractor will not practice blasting. • Local land use permits and ZEMA permits will be obtained prior to material extraction. These areas will be rehabilitated for future use by communities. • The contractor will ensure that sand mining does not affect biodiversity and flows- a method statement should be developed for the sites.	Construction phase Daily	• Refer to the remedial design report • Use of approved and regulated mining process • Refer to the relevant plans' performance indicators	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000
Campsite Management						

Construction, operation and decommissioning activities	Non-hazardous Waste management, Hazardous waste management, noise, wood fuel forest depletion, energy conservation, air pollution due to dust, water conservation, surface and ground water pollution, soil conservation, land pollution/ degradation, health and safety risks	• The contractor will refer to the relevant management plans in the table; air, noise, water, waste, biodiversity, soil, land, health and safety. • The contractor will conserve resources – energy and water. He/she will collect and use what is required in a sustainable way. • The contractor will not use firewood/ forest for energy. • The contractor will not deprive the communities of their resources. • The contractor will not start wild fires or a fire in an undesignated area. Fire safety will be adhered to with extinguishers and assembly points on site. • The contractor will ensure that the location of the campsite will be at least 500m from the school and 150m from the water. The community will be involved in the siting.	Construction phase Daily	• Refer to the relevant plans' performance indicators • Limited vegetation clearance • Campsite operations inspection reports • Well kempt campsite • Decommissioned site after operations as indicated in the decommissioning plan	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month
Traffic Management						
Transportation of materials, vehicle and equipment movements, pedestrian movements	Poor road surfaces, conflict of use with the community, safety hazards	• Contractor will assess available access, rehabilitate if needed and provide appropriate signage where relevant to inform the local community. If any road infrastructure is closed due to the works, alternative routes must be assessed and constructed with minimal impacts on the community social and environment aspects. • The contractor will liaise with the school authorities and the DMC when developing the plan and identifying the road taking safety and awareness into consideration. • Contractor will prepare the traffic	Construction Phase Daily	• Safety inclusion • Existing community access infrastructure • Training records for communities and workers • Inspection reports • Complaints records • Traffic Management Plan in place	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ DMC	HSSE Officer Cost 500/month

		management method statement which will be reviewed and approved by UNOPS in collaboration with IDSP. The method statement will affirm procedures and include cost. The plan will include the need to cover the raw material with a tarpaulin to ensure there is no pollution caused to the local community. Additionally, once the source of raw materials are known, the contractor, working in consultation with the engineer and the local authority will define a route to use during the transportation of the raw material • Contractor will include hazard identification, risk assessment, safety measures such as signage, routes, parking areas, loading, unloading, reversing, crossings, sensitisations, fencing, competent drivers, working hours, operating low speed (about 10 to 20km/h). • In summary the contractor traffic management plan will include: the desired flow of pedestrian and vehicle movements, the expected frequency of interaction of vehicles and pedestrians, illustrations of the layout of barriers, walkways, signs and general arrangements to warn and guide traffic around, past, or through a work site or temporary hazard, and how short term, mobile work and traffic situations will be managed. • Responsibilities of people managing traffic in the workplace, responsibilities of people expected to interact with traffic in the workplace, and instructions or procedures for controlling traffic including in an emergency will also be included by the				

		contractor.				
Biodiversity Management						
Aquatic biodiversity **Works within habitats**	Biodiversity loss and ecological flow limitations	● The contractor will implement the BMPP. ● The contractor will minimize impacts on notable species and loss, fragmentation, alteration, disturbance and disruption of sensitive habitats, as guided in the BMP. ● The contractor will avoid introduction of alien species that may affect other resident species in the waters. ● The contractor and communities will avoid exploiting biological use of resources and invasive methods by following regulations and training. ● The contractor will make reference to the BMP annexed to this document and prepare an aquatic biodiversity site/ habitat specific method statement for works which the Contractor will communicate to the contractor workforce. This will include: ○ Location of the specific works; ○ Any details obtained in the pre-works services; ○ Explicit details of mitigation measures which should be applied in the area; ○ Details of any specific construction practices which should be applied in the area to protect biodiversity; ○ Details of any timing restrictions which apply to works in the area; ○ Restoration details for the habitats within the area where	Construction Phase Daily	• Number and extent of undisturbed areas • Species register • Water quality results • Training registers and species protection regulations	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ Fisheries Forestry	HSSE Officer Cost 500/month UNOPS ecologist consultant costs

		the method statement applies. ● As guided in the BMP, the contractor is required to ensure that all employees receive appropriate training in relation to biodiversity issues, so that the activities do not generate impacts on biodiversity. ● Making reference to the BMP, a separate report annexed as Appendix J , the contractor will maintain ecological services and ecologically rich areas, protect vulnerable and endangered species, and protect nests. ● The contractor will report all incidents to UNOPS and to authorities.				
Terrestrial Biodiversity Works within habitats	Biodiversity and habitat loss	● The contractor will adhere to the Mitigation measures as guided in the Biodiversity Management Plan (BMP) annexed as a separate report to this ESMP ● As guided in the BMP, the contractor is required to ensure that all employees receive appropriate training in relation to biodiversity issues, so that the activities do not generate impacts on biodiversity ● The contractor will take measures to avoid wildfires, and any use of firewood from the cutting of trees around the dam. The contractor must organize alternative energy sources. ● The contractor's works, rehabilitation of roads, operation of material sites and campsites should minimize on destruction of terrestrial biodiversity. ● Contractor to prepare an aquatic biodiversity site/ habitat specific method statement which will include: ○ Location of the specific works;	Construction Phase Daily	• Rehabilitation records and extents • Extents and number of disturbed sites and species • Maintain a fauna sighting and fatality register. Conduct regular monitoring of works to ensure compliance • Training records and fauna register	Contractor Engineer and HSSE Officer UNOPS/IDSP/ Fisheries Forestry	HSSE Officer Cost 1000 UNOPS ecologist consultant costs

		○ Any details obtained in the pre-works services; ○ Explicit details of mitigation measures which should be applied in the area; ○ Details of any specific construction practices which should be applied in the area to protect biodiversity; ○ Details of any timing restrictions which apply to works in the area; ○ Restoration details for the habitats within the area where the method statement applies. • The contractor will report all incidents to authorities and UNOPS				
Community Health and Safety						
Lack of safety measures	Community Health Risks which include accidents, injury and drowning in open sites such as a borrow pit.	• The contractor will install safety signage around the dam reservoir, embankment, crossings, material sources, roads, depressions, pits and other sensitive sites. • The contractor will monitor traffic and road safety throughout the operations in order to maintain a safe working environment, including that workplaces, machinery, equipment and making sure processes under their control are safe and without risk to health. • The contractor will sensitise communities on safety and response, including sensitise communities on vector and waterborne diseases prevention and management • The community living close to the dam and especially those living upstream of the dam shall continuously be informed of the importance of having own convenience to avoid open defecation. This practice can	Construction Phase	• Adequacy of safety signage • Training records • Refer to the technical safety reports • Good quality drinking water according to WHO standards	Contractor Engineer and HSSE Officer UNOPS/ IDSP Ministry of Health	HSSE Officer Cost 3000

		otherwise impact on the surface water quality and consequently may cause water borne disease among the local community accessing this water. • The contractor will adhere to COVID-19 regulations and SI instruments to protect the workforce. The Contractor will incorporate strict COVID-19 prevention and management measures (See Appendix D and F). Adequate hygiene points will be set up around the site, temperature will be measured daily for each worker, suspected cases will be reported to the local clinic etc. • Contractor will prepare the site emergency preparedness response plan which will be in a report and process flow format. This will include training, emergency personnel such as the DMC/ contacts, emergency numbers, hazards identified (chemical, biological, physical or natural disasters), risk levels, evacuation and routes mapping, response-emergency reporting and evacuation procedures, critical operations.				
Occupational Health and Safety						
Poor occupational health for the workers	Injury to workers and Lost Time	The contractor will implement all reasonable precautions to protect the health and safety of workers. To ensure effective management of the works in this respect, contractor is expected to have the technical capability to manage the occupational health and safety issues of their employees, extending the application of the hazard management activities through formal procurement	Construction phase	• Training of workers, record in place • All wokers in rightful PPE • Good house keeping	Contractor Engineer and HSSE Officer	HSE Officer Costs

		agreements. Preventive and protective measures should be introduced according to the following order of priority: ● Eliminating the hazard by removing the activity from the work process. Examples include using an alternative that is less harmful, etc. ● Controlling the hazard at its source through use of engineering controls. Examples include machine guarding, acoustic insulating, etc; ● Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc. · ● Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE. • The application of prevention and control measures to occupational hazards should be based on comprehensive job General EHS Guidelines.				
Gender Equality, SEA and GBV						
Gender Mainstreaming	Work force does not have gender parity	• The contractor will endeavour to recruit 50% women among their locally recruited workforce	Construction Phase	• Contractor recruitment plan includes 50% women	Contractor UNOPS	

GBV/SEA	Sexual Abuse, Exploitation (SEA) and Harassment of work force vis-à-vis the local communities	• The IDSP and UNOPS will conduct stakeholder consultations held with a focus on GBV/SEA and child protection risk. • The contractor will ensure that all workers understand and sign a Code of Conduct (CoC) that reference zero tolerance in regards to GBV/SEA/SH. This also includes consultants and suppliers. • All CoCs will be disclosed through appropriate means (see SEP) – including in the local languages. • The contractor will ensure community and stakeholder awareness on GBV/SEA and child protection response mechanisms. • UNOPS to train senior GRM staff in GBV/SEA appropriate responses and referral mechanisms. Training of the GBV/SEA community focal point persons. • The contractor will ensure that all sub-project-relevant cases are reported to UNOPS (establish agreements with relevant entities, distribute contacts for reporting), if the survivor agrees, based on informed decision making. • UNOPS will monitor developments in the sub-project areas and conduct continuous assessments to understand trends in GBV/SEA/SH and child protection related issues.	Construction Phase	• Reports on results of stakeholder consultations • Field monitoring missions are implemented at least once every month • All CoCs have been disclosed through appropriate means • Contractors has been provided with a standard CoC to use as a minimum • 100% of all workers have been trained in the CoC and GBV/SEA risks and obligations • Community awareness sessions have been implemented at least once • 100% of senior GRM staff has received training session on GBV/SEA responses and referral mechanisms • Agreements have been reached with GBV service providers/ reporting entities	Contractor UNOPS / IDSP	Gender Consultant UNOPS, 16.000/year
GBV/SEA	Sexual Abuse, Exploitation and	• The contractor will ensure the application of a system to prevent SEA in the company • The contractor will ensure that all workers	Construction Phase	• Field monitoring missions are implemented at least	Contractor/UNOPS	Gender Consultant UNOPS, 16.000/year

	Harassment at the workplace	understand and sign CoCs, including consultants and suppliers. • The contractor will ensure all CoC are disclosed through appropriate means and will also be conveyed in the local language, for easy comprehension. • The contractor will ensure that all sub-project-relevant cases are reported to UNOPS (establish agreements with relevant entities, distribute contacts for reporting), if the survivor has agreed based on informed consent.		once every month • All CoCs have been disclosed through appropriate means • 100% of all workers have been trained in the CoC and GBV/SEA risks and obligations		
Labour and Working Conditions						
Labour and Working Conditions	General Risks and Impacts	• Contractors to recruit local workers where possible. • IDSP will establish and implement effective GRM (including address of GBV cases). • Adequate Occupational Health and Safety requirements. This will be in compliance with the local Factories Act and OSHA Act. This includes complying with the safe working conditions and safe acts on site. • The contractor will incorporate strict COVID-19 prevention and management measures (See Appendix D and F).	Construction Phase	• At least 60% of workforce at dam site is locally recruited • Contracts contain labour influx provisions • All workers have signed a Code of Conduct	Contractor UNOPS / IDSP	Included in GRM costs (not specific for labor influx UNOPS staff costs Contractor budget (awareness sessions in communities and for workers): 5.000 USD / 6 months
Covid 19 Pandemic	Spread of Covid-19 pandemic among the workforce and the local community	• The contractor will provide and implement relevant COVID-19 guidelines for all the workers to follow in the quest to avoid/prevent the spread of Covid-19 among the workforce and the local community. This will be consistent with the provisions in the WHO and Zambia's Public Health Regulations on COVID-19 management.	Preparation and construction phases	• Sensitization and actual provision of sanitisers and face masks.	Contractor Engineer and HSSE Officer	**In rehabilitation cost**

Labour Influx	Conflicts between local community members and workers based on cultural differences	• UNOPS/IDSP will conduct local community consultations during the sub-project design and implementation stage, as per SEP. • The contractor will disseminate rigorous information dissemination about sub-project details and GRM, as per SEP (see below). • This will include awareness raising among local communities and workers. • The contractor will provide information on CoC (in local languages). • Contractor to conducts cultural sensitization of workers.	Construction Phase	• Monthly reports received on consultations and key issues identified • Information on CoC has been translated in local language • 100% of workers from outside have received training	Contractor UNOPS	UNOPS staff costs / travel budget of Safeguards staff 20.000 USD / year Contractor budget (costs for awareness sessions / training 5.000 USD / 6 months
Conflicts	Conflicts between workers, based on cultural or other differences Risks of disagreements between local workers and employers	• The contractor will design and implement a workers' GRM. • The contractor will operate workers' GRM.	Construction Phase	• Monthly reports on Workers' GRM received • Reports received on Workers' GRM	Contractor UNOPS	Contractor budget Staff costs and travel budget
Labour Influx	Increased risks of communicable disease, e.g. HIV/AIDS, STDs	• The contractor will implement awareness raising on HIV/AIDS and STD for the workforce. • The Ministry of Health and the district council (environmental health office) will be involved during prevention programmes.	Construction Phase	• Every workers has received training	Contractor UNOPS	Contractors' budget (training costs, awareness raising in community costs, translation costs for COC) 5.000 USD / 6 months
Occupational Health and Safety	Occupational Health and Safety Risks	• Occupational health and safety requirements will include hazard identification-elimination, substitution,	Construction Phase	• Emergency preparedness and response plan for	Contractor UNOPS	HSSE Officer costs

		controls, communicate risks, training, emergency preparedness and response, adequate and relevant personal protective equipment, incident investigations, monitoring. • COVID-19 spread at the construction site to be mitigated through attached plan (see appendix D).		occupational emergency situations • Report on COVID-19 mitigation plan implementation		
Decommissioning and Rehabilitation Measures (structured management to minimise environmental risk of dam construction impacts)						
Erected infrastructure **Demobilization of the contractor's services and equipment used in performing the work required under the contract**	Residue impacts Aesthetic impacts Safety hazards	• The contractor will review of the types of activities carried out on the site, including material extraction, machinery, buildings erected, waste handling and recovery operations. • The contractor will conduct identification of potential hazards, including an evaluation of the raw materials and waste products typically stored on-site, site hydrogeology, ecological effects, control measures for dam safety to prevent incidents, all items of plant and other materials, including buildings that may be decommissioned, rendered safe or removed from site for disposal or recovery in the event of demobilisation and closure. • The detailed rehabilitation plan will be in the contractor's site method statement.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	HSSE Officer costs 40,000
Disturbed work areas and Borrow pits	Soil erosion, aesthetics, drainage, safety hazards	• The contractor will conduct detailed site inspections, define and map disturbed areas where rehabilitation/erosion control is required. • The contractor will develop costed method statements for each area, including problem statement, method of rehabilitation, resources needed and responsibilities. • The contractor will rehabilitate areas	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

		disturbed during construction activities. Disturbed areas will be restored as close as reasonably possible to pre-construction state and the soils will be restored to a condition consistent with other resource uses. Disturbed areas, slopes will be replanted with native plant seed mixes suited to the area. Topsoil that has been stripped and stored as part of the construction activities is to be levelled out as part of stabilization and rehabilitation activities. Correctly preserved topsoil provides viable sources of seeds stock, biological life and nutrient conditions that lead to vegetation establishment in addition to native species that will be purchased for full rehabilitation use. For every tree removed three will be planted. The rehabilitation plan will be in the contractor's site method statement. • Borrow pit rehabilitation – the contractor will partially fill borrow areas with acceptable material (approved by the supervisor's ESS staff) to form a safe landform and covered with topsoil. Drainage should be ensured to avoid accidents and public health risks. The areas of disturbance and steep slopes must be stabilized. The rehabilitation plan will be in the contractor method statement and borrow management plan. • The contractor will implement rehabilitation and monitor effectiveness over three years.				
Access roads and paths used	Soil erosion, aesthetics, watershed	• The contractor will conduct detailed site inspections, define and map disturbed areas where rehabilitation/erosion control	Construction Phase	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer	In rehabilitation cost

	restoration, safety hazards	is required. • The contractor will develop method statements for each area, including problem statement, method of rehabilitation, resources needed and responsibilities. • These roads accelerate erosion and contribute to siltation of the dam as well as water turbidity of the reservoir especially in the rainy season. The Contractor will repair of any existing roads used in accessing the dam site for decommissioning activities. Some of the unnecessary paths around the dam should be closed by ripping and planting of vegetation. Restoration of any over ground access areas through replanting of native plant seed mixes suited to the area at three trees per one removed tree. Local/ native species are indicated in this ESMP. • The contractor will create an ideal and safe crossing downstream of the dam. Crossing over the embarkment may not be safe for the community. • Natural regeneration and adequate full area coverage assisted vegetation using native vegetation species will be implemented and monitored by the contractor. • The contractor will ensure that the rehabilitation plan will be in the contractor's site method statement and management plan • The contractor will implement rehabilitation and monitor effectiveness over three years.	After conclusion of works		UNOPS/ PIU	

Campsite	Land use and aesthetics	• The contractor will remove all campsite facilities retaining those that need to be handed over to the community /DMC (if there will be any), for use. After accomplishing the dam construction works and before handing over, the campsite should be rehabilitated in an environmentally sound and acceptable manner to satisfy ZEMA regulations.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Contaminated materials and hazardous waste	Soil and water Pollution safety hazards	• The contractor will conduct detailed site inspections and prepare a snag list. Prepare snag list defining each area where remedial action is necessary, including location of waste oil drums and/or other hazardous chemicals, location of oil-contaminated soils and the required actions • The contractor will where possible return some materials to the suppliers, e.g. diesel and disinfectants for resale or reuse. The remaining materials be disposed of as waste, some of which may be deemed hazardous waste due to their composition e.g. oils. Such materials will be disposed of off-site in accordance with appropriate waste management regulatory requirements and facility waste management procedures. Soil contaminated with hydrocarbons will be excavated up to clean material beneath the base of the to the contamination plume and bio-remediated in a land farm. Where the contamination plume is willow, in-situ bio-remediation will be conducted using nutrients and enzymes. Such sections will be mapped and backfilled with fresh soils. The rehabilitation plan will	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer Supervisor/ PIU	In rehabilitation cost

		be in the contractor's site method statement.				
Pit Latrines	Pollution of groundwater and soil, safety hazards	• The contractor will decommission all VIP pit latrines that will be constructed by dismantling and the pits buried after applying lime. The rehabilitation plan will be in the contractor's site method statement.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Waste heaps and non-hazardous waste	Landscape impacts, safety hazards	• The contractor will develop a snag list and conduct site inspections. • The contractor will ensure that rubble including vehicle and machinery parts and derelict components are removed from the site and transported for disposal at a ZEMA/ local authority certified damp site. All the heaps of soil will be levelled and areas that were used as workstations will be re-vegetated. The rehabilitation plan will be in the contractor's site method statement.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Stock piling	Land use and aesthetics safety hazards	• The contractor will ensure that all heaps of overburden material should be used to back-fill the borrow pits and the sections properly levelled to suit the natural landscape. • Stock-pilling/preservation of the felled trees - The recommended practice is that The Contractor is required to stockpile all the felled trees. There will be no burning of burying any felled trees.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Reservoir Water Quality	Ecological services and aesthetic impacts	• The contractor will set up a designated livestock area on the upstream that will be stone pitched for controlled livestock movement and watering to prevent soil movements. • The ground will be prepared and then	Construction Phase	• Livestock watering area at the basin	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

		pitching will be done before vegetation is planted.				
Embankment fencing **Embankment structural works**	Forest cover loss threats Embankment failure	• The contractor will install metallic poles in a liner fashion for the animal barricade at the ends of the embankment wall to replace the temporary log fencing. • The contractor will completely dig out ant habitants and their tunnels exposed and broken down then backfill and compact with suitable fill material.	Construction Phase	• Permanent fencing to keep animals away from the embankment	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Environmental Flow	Ecological flows	• The contractor will install the user friendly durable flow gauge for regular flow measurements during runoff season. • Ensuring balancing of flows and ecosystem needs, suggested in the BMP. • UNOPS will conduct training for the DMC on flow reading.	Construction Phase	• Training and flow monitoring	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
Non Hazardous Waste Management						
Construction and Operation activities	Waste releases from local communities Public health and safety hazards Potential waste types include domestic solid waste due to activities around the dam- plastics, containers, boxes, papers	• The DMC will be trained on household waste management. There will be no disposal or storage of waste at the Makaba dam site.	Operation Phase	• Properly designated waste collection and disposal points • Training/ sensitization records • Waste disposal records and logs • 100% of sites are cleaned up	DMC/ Water User Committee Ministry of Agriculture DWRD	500/month
Hazardous Waste Management						
Operation activities- pest management, fertilisers	Hazardous waste generation and releases into the environment- Chemicals	• IDSP, Ministry of Agriculture, Department of fisheries will train the communities on operation activities that minimise pollution of water. These are outlined in the capacity and training program. • Refer to IDSP Pest management plan	Operation Phase Monthly	• Non-polluting farming, animal watering and fishing methods (e.g. farmers not to push nitrate-based fertilizers into the surface water/dam) are applied • Training/ sensitization	DMC/ Water User Committee Ministry of Agriculture DWRD	100/month

				records, 100% • Water quality monitoring records	IDSP	
Surface and Groundwater Pollution Management						
Livestock watering and activities in the water **Irrigation activities**	Siltation Poor water quality Pest management	• The IDSP will conduct and promote community farming methods that will not pollute the water- chemicals or runoff and soil erosion • Pest management training and monitoring • Catchment management community training • Refer to IDSP Pest management plan	Operation Phase Quarterly	• Water quality results from the dam and main tributaries in the catchment • Pollution control structures • Training and sensitisation records	DMC Ministry of Agriculture Forestry IDSP	Once off- 20,000 700/month
Sanitation Management						
Community sanitation	Environmental pollution, public health risks	• The Community will be trained in the impacts of open defecation	Operation Phase	• Existing adequate sanitary facilities	DMC Ministry of Health	
	Breakout of water borne disease as a result of poor sanitation practices by communities living upstream of the dam	• Sensitization of the local community both those living upstream of the dam and those living around the dam, using a programme called Community Led Total Sanitation Programme (CLTS). This programme compels the members of the community to have at least a toilet per household. This in turn reduces and completely stops open defecation by the same community members.	Construction and Operation Phase	• Records of sensitization programme stating where sensitization took place, how many of these programmes, name and number of villages attended.	During Construction IDSP working with Ministry of Health During Operations Ministry of Agriculture working closely with Ministry of Health	
Pedestrian Infrastructure Management						
Maintenance of access infrastructure	Deterioration of access infrastructure	• IDSP will sensitise school and the community on appropriate use of the infrastructure to avoid and minimise	Operation Phase	• Training records • Inspection records • Maintenance records	DMC IDSP	500/year

	Spillway crossing hazards Safety hazards	failure. It will carry out regular inspection and maintenance of the infrastructure, and maintain the infrastructure and safety measures • IDSP will train DMC on use, maintenance and monitoring requirements	Quarterly			
Basic Biodiversity Management						
Aquatic biodiversity	Biodiversity loss and ecological flow limitations, population increases	• The Biodiversity Management Plan (BMP) will be implemented accordingly to ensure appropriate measures are put in place for biodiversity conservation purposes where feasible • Maintain ecological flows all year round and integrity of the ecological function • UNOPS to increase basin water holding capacity by rehabilitating the structure in order to enable constant downstream flows and basin water levels. Otherwise the basin may run dry. This would also relocate the aquatic species from the dam. A system for equitable allocation of water is based on available supply. • Include gauge levels monitoring facilities. DMC to strictly monitor inflows, retention water and outflows in order to have a balanced system. • UNOPS to include outlet infrastructure for downstream flows. • DMC to monitor the erosive capacity of the streams downstream for sediment barrier occurrence upstream. • DMC to monitor flow level changes downstream. Natural flows and dam controlled flows. • Communities to protect vulnerable and endangered species. • Avoid exploiting biological use of	Operation Phase	• Ecological flows monitor • Relevant quantity, quality and timing of water flows required to sustain ecosystems and the human livelihoods and well-being that depend on these ecosystems • Training records	DMC Fisheries Forestry UNOPS IDSP	100/year

		resources and invasive methods. • MoA working with Department of Fisheries to train the community and DMCthat benefit from the ecological value of the dam so they can learn sustainable fishing skills and preserve the fish juveniles in the shallow waters • Secondary developments to take aquatic biodiversity into consideration.				
Terrestrial biodiversity, operational activities	Biodiversity and habitat loss	• The BMP will be implemented. • Active control of invasive and alien species after trainings by government departments. The community will incorporate catchment management measures habitats around the dam. Avoid displacements and over exploitation of species.	Operation Phase	• Biodiversity conservation measures in place	Fisheries Forestry Ministry of Agriculture	500/year
Communication and Community Engagement						
Communication to Stakeholders	During operational phase, dam is not managed well by local communities	• IDSP to train DMC in E&S issues indicated in the UNOPS and contractor training plans.	Operations Phase	• DMC exists • DMC has been trained	IDSP local authorities	2000
Catchment Management						
Catchment management	Increased erosion and sedimentation	• The IDSP will ensure the DMC and officers from the departments of forestry, water resources and agriculture are oriented to appreciate the contents of the 0&M manual, use and benefits for sustainable management of the dam catchment area.	Operation Phase	• Training of the following in the implementation of O&M: • DMC • Water resources development • Agriculture • Campsite officer	IDSP DWRD DMC	In training costs

				• Forestry		
Community Health and Safety						
Lack of safety measures **Dam use Crossings**	Public health risks and diseases Drowning Injury Dam failure	• The communities will be trained by IDSP and government departments in maintenance of safety signage around the dam reservoir, embankment, crossings, material sources, roads. • The contractor safety signage plan, location and type will be presented for approval to the supervisors and PIU by the contractor. Safety areas will include undesignated or risky crossing points or activities around the dam, community warning prior to opening any valves, flooding, health, safety, planning, prevention and response, reporting faults and security measures at the dam.	Operation Phase	• Inspection reports • Training records • EPP revisions and reviews • Safety signage Plan and records • Refer to the technical safety reports	DMC Ministry of Agriculture DWRD IDSP	1000
Gender Equality and GBV Action						
Gender Mainstreaming	DMC do not have female members	• UNOPS will define gender parity in constitution of the DMC and include gender equality training in the training of DMC.	Operation Phase	• DMC have 50% female members	Ministry for Social Services	Included in training costs above
Maintenance and Monitoring Management						
Dam maintenance	**Structural deterioration** **Dam Management**	• The IDSP will conduct further DMC trainings on dam maintenance and dam safety. • The DMC will ensure incidents are reported to the resident IDSP staff and responded to. • UNOPS and IDSP will conduct maintenance and flow inspections trainings for communities and district officers. • IDSP will conduct periodical dam safety	Operation Phase Bi annual	• Dam committee Quarterly meetings and resolutions • Flow measurements and action plans • Training records	IDSP DWRD DMC	1000/ year

		assessments. • IDSP will employ record keeping for the dam maintenance works done by the department and by the community.		• Dam maintenance records and monitoring records • Refer to the technical safety reports		
Monitoring measures	Lack of monitoring	• IDSP will conduct water quality measurements for parameters indicated in this ESMP. • IDSP will conduct and follow up on flow measurements. • Community will implement catchment management measures with the Department of forestry • The Ministry of Fisheries and Forestry will conduct biodiversity monitoring as guided in the BMP	Monthly	• Refer to the biodiversity assessment and BMP • Monitoring records • Pictures • Training records • Flow measurements • Catchment management activities • Water quality results, monthly The monitoring parameters will include biological, physical and chemical drinking water quality parameters. These will include	IDSP DWRD DMC	1000/ year

				parameters analysed in this ESMP: pH, conductivity (µg/cm), sulphates (mg/l), nitrates (as no3-n mg/l), total dissolved solids (mg/l), ammonia (as nh4-nmg/l), phosphates (mg/l), total suspended solids (mg/l), chemical oxygen demand (as mg o2/l, chlorides (mg/l), turbidity (NTU), hydrocarbons (mg/l) additionally with total and fecal coliform tests. • If hydrocarbon contamination is suspected, the test will be included. The testing will be		

				done at certified/ approved laboratories after proper sampling methods.		

7.2 Rehabilitation and Remediation Plan for the Previous Works' Sites

This section discusses aspects requiring rehabilitation before the contractor demobilizes from the project area. The remediation plan is to a larger extent covered in the actual design works for remedial works, and hence limiting the discussion in this section to those aspects which are non-structural. This plan is prepared in reference to the ESA Table 9-2 'Requirements for rehabilitation plan' which requires that rehabilitation specifications for embankments, borrow pits, access roads / tracks created during past construction/ and any areas of downstream erosion / embankment destabilization that has been caused by the previous construction works and the initial operation of the dam are prepared.

The main purpose of this plan is to:

- identify, rehabilitate and remediate the existing previous dam construction areas, which have environmental and safety issues;
- identify, rehabilitate and remediate existing incomplete dam construction works and sites to enable completion;
- outline the requirements to return previously disturbed sites to a state which is similar to the state prior to construction.

One limitation of this plan is that full restoration may not be possible, therefore rehabilitation and remediation with the aim to meet continuing or changing uses is foreseen. This rehabilitation is part of the main project construction works. Therefore implementation of this ESMP applies with an active DMC role during and after construction for maintenance and monitoring.

The rehabilitation works are elaborated in the table below:

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
			Structural risks			
Embankment	Location: Embankment top surface, slopes, toe Images: Section 5 'Dam Characteristics'	Refer to the dam design reports Protect both upstream and downstream slopes from livestock damage, stone pitching (both faces will preserve the slopes more)	*Timing:* commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation role: construction contractor Supervisor: UNOPS	Contractor liability period Site inspections pictures Continuous maintenance	Embankment stabilization	In BoQ

	Risks: structure failure, seepage, termites	Raise the wall by 2.5m to address many of the uncontrolled seepage issues along the entire length of the toe Carry out downstream raising by easing the downstream slope to 1:2.5, include adequate filters, a more substantial rock toe and place suitable shoulder material Incorporate a 500mm wide chimney drain for the entire length of the embankment Remove the top 1.5m of embankment and use it in the construction of the expanded embankment Repair upstream slope above the water line and place stone pitching to cover the complete surface - mainly to prevent future livestock damage	*Materials and equipment* Earthworks Sand- quantities 260m^3., Rock quantities 500m^3., Crusher runner from a commercial quarry , quantities 260m^3 The equipment required includes: backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator *Workmanship* Up to 10 machine operators and 15 laborers as per above and up to 4 months for the equipment		
Spillway and drop structures	The structures have temporary sandbags to control erosion. Eroding/ gullying return channel and training wall	Refer to the dam design reports. The contractor must prepare a method statement for the eroded spillway area requiring revegetation. Maintain the same width of spillway and return channel and install 1m drop gabion bolsters, in steps down to the	*Timing:* Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation role: Construction contractor Supervisor: UNOPS	Contractor liability period Site inspections pictures Continuous maintenance	Gullying and erosion protection In BoQ

Images: Section 5 'Dam Characteristics' Risks: structure failure, soil loss, continuous water loss from the basin	riverbed with 4 x gabion drop structures Redefine current spillway sill at FSL using a gabion basket structure with gabion abutments, with wing walls and cut off walls to the height of the newly raised embankment crest and construct at both ends of the new gabion reinforced spill section Excavate the approach channel to the spill section across a width wider than the spillway itself and extend upstream from the spillway at least 100m This is to allow for unrestricted flow over the full width of the spillway so it can operate at its design capacity Control the return channel with 3 gabion drop structure bolster lines at 1m vertical intervals, back down to the riverbed level Reduce the willow undercut of the structure Step the channel and level across its width between each drop and use suitable material for the embankment raising or the training wall remedial works	*Materials and equipment* Rock, quantities 150m^3 Equipment backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship and timeline:* up to 3 machine operators and 25 laborers as per above and up to 4 months

		Run a 2m gabion mattress up the entire embankment both upstream and downstream of the head walls and tie into the head wall and link into the mattresses Backfill any gullies remaining after each step down and low spots with rock and level to provide an even surface for the water to flow over				
Non-structural risks						
Waste and rubble snag list	Not present on site					
Hazardous waste snag list	Not present on site					
Borrow pits	Location: one existing borrow area on the left side of the dam next to the left flank leading into the dam. The extent is about 25m x 35m. This pit floods in the rainy season and is then used as a watering point for the animals. The borrow slopes are open with signs of erosion, uneven excavations and overburden soil heaps.	Detailed site specific method statements will be prepared by the contractor with methods and quantities. Earthworks, rehabilitation of the sites to promote drainage, aesthetic uniformity, revegetation by seeding and natural succession vegetation, slopes and safety. Partially fill borrow areas with acceptable material to form a safe landform and cover	*Timing:* day works-commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation role: Construction contractor Supervisor: UNOPS Remedial works will include earth ripping to enable regrowth of natural	Contractor liability period Site inspections pictures Continuous maintenance during the 3 year maintenance period	Contouring Drainage Stabilized slopes Desired landform	In provisional sum Day works

Refer to the Land Use Map in section 4.1.6 Coordinates: Borrow area- 16°5'57.68"S, 26°51'17.44"E Risks: community health and safety, biodiversity loss	with topsoil (there are some top soil vegetated heaps around the downstream borrow pit) or grade to a desired landform slope and drainage. Stock the existing vegetated sites' soils during borrow rehabilitation and place back when works are done. Plant native seeds in addition to the replacement of top soil to ensure coverage. Construct appropriate surface slopes with drainage channels to prevent water from collecting at the site. Final slopes within the site will be a maximum horizontal to vertical slope (H:V) of 3:1 or 33% grade. Ensure drainage should to avoid accidents and public health risks. Stabilize the areas of disturbance and steep slopes. Implement reinstatement by natural succession together with full cover assisted vegetation seeding interventions, which will require intense monitoring and maintenance within the	vegetation. Assisted vegetation (seeding and soil fertilization with watering) will be included on all sites to supplement possible natural vegetation. The unnecessary roads should be close by scarifying the roadway, ripping and recontouring. Re-establish natural drainage patterns on the closed roads. *Materials and equipment* Earthworks Spoil Soils for top soiling within the borrow area stockpiles Grass seeds- approved noncompetitive native species Watering equipment Fertilizers/ soil fertility promoters Equipment backactor; tractor dumpers; and haul truck *Workmanship and timeline:* up to 6 machine operators and 5 local workers for less than 4 months.

		3 years maintenance period. This will include sub-base preparation, top-soiling, fertilizing and seeding for each area which requires rehabilitation.				
Access routes	Location and condition of the sites: the access road (7Km off the Choma-Namwala Road) is in a very poor condition, eroded over the years with poor surface. The contractor did not repair the road after or during works. The road goes through a school which is close to the dam, 200m away. Alternative roads are given on the Land use map. The road that will not be selected for use during works will be rehabilitated during the commencement of works (Refer to Land Use map). There is one main pedestrian path over the embankment used by the community to access social services. Access is inhibited by the spillway due to water logging and fast flowing water during the rainy	Detailed site-specific method statements will be prepared by the contractor with methods and quantities. Rehabilitate and close the roads left by the prior contractor, which will not be used by the current construction contractor and community Spillway works will make provision for community access. Road rehabilitation will be done by earth ripping to enable possible regrowth of natural vegetation even as assisted vegetation will be implemented on full coverage of the areas. Close unnecessary road by scarifying the roadway, ripping and recontouring. Create an environment supporting over ground with natural regeneration to	*Timing:* day works- commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Construction contractor Supervisor: UNOPS *Materials and equipment* Earthworks Limited gravel utilizing existing surface to form with a grader and tractor dumpers Grass seeds- approved noncompetitive local/ native species Watering equipment Fertilizers/ soil fertility promoters *Workmanship and timeline:*	Contractor liability period Site inspections pictures Continuous maintenance during the 3 year maintenance period	Ripped roads for revegetation	In provisional sum Day works

	season. An access point is proposed for this site over the spillway or downstream. Images: Section 5 Risks: biodiversity loss, accidents, drowning	support the assisted vegetation. Assisted vegetation will included seeding, watering and maintenance of locally adapted vegetation. Re-establish natural drainage patterns on the closed roads. A road/ bridge is proposed over the spillway.	4 Operators and 8 laborers as per above equipment 4 days per equipment			
Eroded and disturbed areas	Open areas around the basin, downstream spillway training wall area, material area slopes Livestock watering contributes to soil loosening Risk: dam basin siltation, soil movements and loosening	Detailed site specific method statements will be prepared by the contractor with methods and quantities. Implement reinstatement by natural succession with assisted vegetation seeding interventions, which will require intense monitoring and maintenance within the 3 years maintenance period. Include sub-base preparation, top-soiling, fertilizing and seeding for each area that requires rehabilitation. Develop a costed method statement for disturbed sites. Designate livestock watering points and promote soil stabilization by stone pitching, compacting and/ or trough creation as an	*Timing:* day works-commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Construction contractor Supervisor: UNOPS *Materials and equipment* Earthworks Compacting, stone pitching material and native vegetation seeds for soil stabilization method Concrete trough, pump, tank Tractor dumpers; and haul truck for materials	Contractor liability period Site inspections Pictures Continuous maintenance	Soil stabilization	In provisional sum Day works

		alternative watering mechanism to keep some animals from the dam basin. The last option is the more expensive one of the two.	*Workmanship and timeline:* 10 laborers and 1 month use of the equipment			
Community Health and Safety	Lack of safety signage around the dam Lack of safety and health sensitization over the dam Risk: accidents, malaria and other waterborne diseases due to lack of knowledge and signage warning	Include a method statement for the design of signage and location mapping (approved by the supervisor). These will be design approved standard dam safety signage around the dam and contractor sites for construction and operational phases. Finalize the planned community sensitizations and trainings and administer. Trainings include issues such as drinking water health, water borne diseases, avoidance of dangerous spillway crossings, swimming risks, emergency preparedness in floods or dam failure, EPP, safety signage, etc…	*Timing:* day works-commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Construction contractor Supervisor: UNOPS *Materials and equipment* Training plans Signage design and subcontractor Signage installation *Workmanship and timeline:* One trainer person Signage installation 3 laborers	Contractor liability period Site inspections Pictures Continuous maintenance DMC regulation	Training records in all stipulated topics Existing correct signage Signage method statement	In provisional sum Day works
Irrigation infrastructure	Location and condition of the sites: failed support for canal crossing over spillway	Detailed site specific method statements will be prepared by the contractor with	*Timing:* construction and operation phase	Site inspections Pictures	Existing permanent canal support	In provisional sum

after the 3rd 'washaway' drop structure channel due to the spillway widening/ loss of support. Concrete lined channel broke and was replaced by a folded iron roofing sheet and wood support by the community There are no pipe outlets through the embankment in the current configuration of the Makaba Dam. Irrigation requirements are catered for by means of two siphons in the form of 150 mm concrete encased steel pipes set at the level of the dry freeboard and feeding into concrete lined channels Refer to images in Section 5 Risk: irrigation/ canal loss	methods and quantities. Permanent support for the canal crossing the channel. Erosion control of slopes in the spillway drop structures channel. The raising of the embankment will present the opportunity to include suitably designed, more robust siphon arrangements	Implementation Role: IDSP, DMC Constructor will work on the embankment as indicated under engineering design Supervisor: UNOPS during construction phase *Materials and equipment* canal material siphon material *Workmanship and timeline:* 4 persons (indicate expertise and No.)	Continuous maintenance DMC Livestock regulation and control	Irrigation siphon within embankment not over the embankment	Day works	

Flow gauges	Downstream flows	Flow monitoring	*Timing:* day works- commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Construction contractor, DMC Supervisor: UNOPS *Workmanship and timeline:* 1 operator and 4 laborers concrete mixer and poker vibrator equipment type and days	Contractor liability period Site inspections Pictures Continuous maintenance and biodiversity monitoring	Installed monitoring gauges Training records	In provisional sum Day works

8 Capacity Building

Community / Stakeholder Health and Safety Training Plan

In compliance with the policy and legal framework, the environmental and social assessment recognized some training and knowledge gaps in relation to construction and operation phases of the Makaba Dam. Capacity building will be the process used by which individuals and departments obtain, improve, and retain the skills, knowledge, tools, and other resources required for dam safety and environmental management at the dam. The training plan in Table 13 has been proposed for capacity building of district government staff, DMC members and community members (upstream and downstream). The implementation and execution of the sub-project will include additional training of relevant staff and communities, stationed in the various sites, in environmental and social due diligence during construction and operation. UNOPS will supervise the training on behalf of IDSP. Identified trainers include: staff of local health center, district department representatives, UNOPS E&S Team, UNOPS Dam Safety Team, IDSP and the contractor.

In addition, the contractor will include in their work plans and carry out training of workers on the required safeguards they are expected to implement as part of the daily activities. The training material will be derived from the ESMP and the sub-project's Technical Dam Safety documents, and other sources. This section does not cover the contractor's training requirements, which are detailed in Appendix H.

Monitoring of the training activities will be conducted by the IDSP and UNOPS by reviewing the training materials, filing training records, noting feedback and following up on recommendations/ action plans.

The training topics include:
For District Officers;

- Policy and legal framework
- Monitoring measures and procedures
- Dam safety management
- Maintenance and ESMP requirements/ roles
- Stakeholder Engagement Plan
- Dam operation and roles

For Communities;

- Policy and legal framework
- Dam safety management including Emergency Preparedness and Response
- Community health and safety, including drinking water and water borne diseases, avoidance of dangerous spillway crossings, emergency preparedness in floods or dam failure, swimming and drowning risks, first aid in the event of potential drowning, risks of crossing at the dam spillways, management of livestock around the dam, malaria prevention and management, bilharzia prevention and management, management of other water borne diseases, use of dam water for drinking and emergency preparedness interactions with wild animals
- Grievance Redress Mechanism (GRM) and GBV
- Maintenance and ESMP requirements/ mitigation measures and monitoring.
- Dam operation and environmental flow
- Catchment management

- Biodiversity management and monitoring

The proposed training plan is shown in Table 11.[31]

Table 10: Training plan

Training Content	Number of Days, Time, Frequency	Trainers / Supervision	Participants
Dam Safety-Emergency preparedness, and Community health and safety			
Emergency preparedness: Key Training Concepts: Hazards, floods and dam failure, roles and responsibilities, emergency preparedness, emergency response procedures and grievance redress mechanism *Community health and safety:* *Key Training Concepts: Pedestrian access infrastructure, Construction safety, Gender based violence, swimming risks, drowning risks, dam security, spillway crossing risks, management of livestock around the dam, use of dam water for drinking, wild animals, malaria prevention and management, bilharzia prevention and management, water borne*	5 After ESMP disclosure prior to construction works Repeated after 3 months and at completion	UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist Government: Local Health Post representative IDSP: Dam Safety Specialist Environmental and Social Specialist	100 community members 15 District DMMU members DMC

[31] UNOPS to have overview over planning and execution of training on behalf of the IDSP/P

diseases, dam maintenance and ESMP monitoring *First aid: First aid basics and response*			
Estimated Costs: 2,000 USD per session			
Grievance Redress Mechanism and ESMP monitoring requirements			
Key Training Concepts: Sharing of the Environmental and Social Management Plan (ESMP) by IDSP/ Contractor to the stakeholders	2	UNOPS: Environmental Specialist Environmental health and safety Specialist Dam Safety Specialist IDSP: Dam safety Specialist Environmental and Social Specialist	18 District Officers 2 officers from each of the following Departments: • Town Council • Ministry of Chiefs and Traditional Affaires • DWRD • Ministry of Health • Forestry Department • Ministry of Gender • Community Development • Ministry of Fisheries and Livestock • Ministry of Agriculture
Estimated Costs: 1,500 USD			
Dam operation activities			
Key Training Concepts: Fishing regulations, species, fisheries conservation, catchment management, environmental protection, forestry regulations and biodiversity	3 At works commencement and repeated annually	UNOPS: Environmental Specialist Environmental health and safety Specialist Government: Agriculture Fisheries Forestry	100 community members

conservation measures, dam sustainability, nurseries, farming methods and dams, sustainable irrigation, pest management, water pollution, crop selection, soil conservation methods		Community Development IDSP: Dam safety Specialist Environmental Specialist	
Estimated costs: 1,000 USD per session			

9 Stakeholder Engagement

The Stakeholder Engagement Plan seeks to define a structured, purposeful and culturally appropriate approach to consultation and disclosure of information during the preparation of the ESMP and implementation stage. UNOPS and IDSP recognise the diverse and varied interests and expectations of stakeholders and seek to develop an approach for reaching each of the stakeholders in the different capacities at which they interface with the sub-project. The aim is to create an atmosphere of understanding that actively involves project-affected people (PAPs) and other stakeholders leading to improved decision making.

Overall, this Plan defines the stakeholder engagement requirements in regards to a) engagement prior to remedial works about the immediate dam safety concerns; b) engagement during (and related to remedial works dealing with construction impacts; and c) engagement in regards to the long term use of the reservoir, maintenance of infrastructure, ensuring vulnerable groups benefit from the sub-project, community health and safety, etc.

While COVID-19 restrictions are still in place, strategies will be employed to include smaller meetings, small FGDs to be conducted as appropriate taking full precautions on staff and community safety. Where meetings are not permitted, traditional channels of communications such as radios and public announcements will be implemented.

9.1 Grievance Redress Mechanism

Stakeholder engagement includes access to a Grievance Redress Mechanism (GRM) implemented by IDSP. The GRM is designed ensure that feedback can be received in relation to the remedial works for the Makaba Dam. It is set up to respond to concerns and grievances of the local communities and to receive feedback related to the environmental and social performance of all activities.

Stakeholder engagement forms a fundamental element to ensure that the GRM process and relevant contact details are well communicated to the respective communities in the dam areas, and that communities are consulted on the performance of the GRM to allow for potential adjustments where needed. This Stakeholder Engagement Plan lays out how the GRM protocols are disseminated to all stakeholders.

DMC members thereby play a key role in the GRM, as they receive grievances or feedback from community members in person; hold the keys to suggestion boxes and regularly empty them; assess and clarify grievances; provide feedback to the community members; investigate grievances; provide appeals mechanisms for unsatisfied community members; document all grievances in a log/register; and report all grievances and their processes on a monthly basis to IDSP.

9.2 Stakeholder Participation

The preparation of the ESMP has relied significantly on local level stakeholder engagement in order to gain understanding of the needs of the dam communities, and potential risks and impacts as well as mitigation measures of the planned rehabilitation activities.

Stakeholder consultation was conducted through review of previous engagement notes from the WRDP reports, key informant interviews with government stakeholders, and focus group discussions and community consultations held during sub-project preparation. COVID-19 regulations were adhered to during engagement. The attendance sheets are shown in Appendix F.

It is important that affected communities and other stakeholders are given the opportunity to continually participate in the process during the remedial works. Therefore, consultations were held:

- To provide information about the previous and current sub-project and to get stakeholder information on key environmental and social baseline information at the sub-project site;
- To receive information on legacy site impacts of the previous project in relation to non-rehabilitated sites;
- To provide opportunities to stakeholders to discuss their opinions and concerns;
- To identify specific interests and to acme potential roles and responsibilities of stakeholders and ensure their approval and participation in the development of the ESMP; and
- To inform the process of developing appropriate management measures as well as institutional arrangements for effective implementation of the ESMP.

A summary of the views and concerns raised during the consultations and field visits to the Makaba dam communities are stated below:

Department/ organization	Concerns/ input	Response
District commissioner and council	• Works on the dam need to be done properly and with resilience in mind so that the benefits last, as there have been works before in the same areas on the dam • Proper material must be used to repair the cracked spillway structures • The project team to inform and update the office when on site • The ESMP must be communicated to the district council before works commence • The council and Ministry of health has to be part of the social protection programmes such as HIV/ AIDS prevention programmes	• All identified risks and dam failures have been considered for rehabilitation • Approved and correct materials will be used for construction • A competent contractor will be selected • The stakeholders will be informed when works begin • Project documents will be made available to the council and DC office • The council will be involved in the programmes set

		out in the ESMP until end of construction
Community development	• The district departments have had many meetings over the dam. The dam structure has cracks • The district is vulnerable due to climate change and poverty levels • The sub-project must maintain the whole dam and promote dam use activities • The department sensitizes communities on a lot of issues such as livelihood, vulnerability • Women face many inequalities in society. They are now learning to take part in activities with men • GBV organizations/community development, social welfare, VSU, education • There is a district child protection committee for children and women human rights. This committee is composed of district representatives from various departments. They still require capacity building and funding • Gender mainstreaming sensitization programmes are necessary in the community. This will bring in more women.	• The dam will be rehabilitated to maintain its purpose and promote use for livelihood improvement • Women will be involved in the construction and operation of the dam • GBV prevention plan has been prepared • Child labor prevention guidelines have been included in this ESMP
Forestry	• Officer was not familiar with the site. The project must include stakeholders to point where they organize trainings and field visits • The dam has been discussed in district meetings • Revegetate open spaces. Revegetation must include the right tree species that won't drain the dam water but supplement the water, and are indigenous • Nature such trees to maintain the dam • Trees that hold soils and consolidate for the dam wall. Even if water goes over the dam, the structure should till hold • Involve forestry in the process. Seeds are available in the district. The department can be engaged in seed collection. Charcoal making is now increasing in the district. This threatens sustainability of dams and streams due to soil erosion	• Trainings have been included • The Ministry will be involved • Vegetation planting is part of the management measures in the ESMP

Fisheries and Agriculture	• The communities are interested in fishing activities • There was a planned 500m canal which was not completed, only 250m was done on each side • Fisheries stocked the dam after construction • Makaba Dam has not been monitored due to tree stumps in the water - no test fishing was done. However the dam still has a lot of fish • The stumps were left in water to avoid net fishing by communities • The communities are supposed to communicate the quantity weight of fishes caught for monitoring purposes • Hooks are encouraged for fishing • The dam has never dried up, so there is no feed for restocking • The types stocked- white bream, red breasted bream, niloticus, green headed bream • This was a new dam, so these were initial species • Niloticus has no effect on the other communities of fishes in the river system. They can survive in shallow waters. They are cultured adaptive species. Red breasted spotted original species are lost. • They sometimes go where water is going. If spillway is not maintained they go with the water • Water levels in the dam must not get very low Recommendations: • Training and capacity building • Creation of fishing grounds for testing • Headmen and chiefs training and sensitizations to be undertaken • Incentives to be included with penalty for net fishing • Monofilament nets have been banned in the country • Committees can use it for test fishing • Fisheries Act does not apply to Dams/ ponds but natural waters • Cement is toxic to the fish • Tilapia struggles in dams due to little food.	• The canal must be rehabilitated and completed- recommended in this ESMP • Spillway rehabilitation has been included in the design and new works • Fish protection measures have been recommended
Communities	• Works on the dam need to be done properly and with resilience in mind so that the benefits last as there have been works before in the	• Complete remedial works have been recommended

same areas on the dam. Proper material must be used to repair the cracked spillway structures • Women do not take part in activities such as employment as the men believe this interrupts marriages • Women are interested in working and employment. Employment must involve locals • Canals are operational but short in distance, instead of the planned 500m on each side, only 250 m was done. The spillway channel is deepening and widening and affecting canal route. • Need for access point. Community uses embankment and spillway for access to social services • The 7km only vehicular and pedestrian access road from Choma-Namwala Road is in a poor state. This needs rehabilitation. • This also affects safety due to possible falls. There is no safety signage, sensitization or emergency response in place at the dam • Employment of locals will be beneficial both, men and women • Reduce labor influx and minimize such effects on the host population • Contractors to engage the DMC for local knowledge • Canals are narrow, they use cups to scoop water for irrigation. Can this be rectified?		• Canal rehabilitation and extension recommended • Access point over spillway included in the rehabilitation plan • The contractor road from the junction to the dam has to be rehabilitated- included in ESMP • Local employment will be prioritized by the contractor

9.3 Stakeholder Communication Plan

Information disclosure will rely on the following key methods: community meetings in coordination with local authorities (headmen, DMC and district administration), community notice boards, phone communication (SMS), and radio broadcasts. At the national level information will be disclosed mainly by email and on the IDSP and UNOPS websites. Information will be disclosed in English, which is the official language of Zambia. Local authorities, such as the District Administrator, local headmen, the Makaba DMC and the District Disaster Committee will be requested to inform communities in community meetings and through disclosure on social media where feasible.

Table 11: Stakeholder communication plan

Phase	Item to be disseminated	Actions	Responsibility	Registry Format
Information dissemination prior to remedial works about the immediate dam safety concerns	GRM	Community meetings with local headmen, DMC, District Disaster Committee, community members – with social distancing Community notice boards Radio announcement / broadcast Email – national level stakeholders	IDSP Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message
	ESMP	Community meetings with local headmen, DMC, District Disaster Committee, community members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc… – with social distancing Community notice boards Radio announcement / broadcast Email / website – national level stakeholders	UNOPS Social Safeguards Specialist and IDSP Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message, website
	Information on dam safety concerns	Community meetings with local headmen, DMC, District Disaster Committee, community members – with social distancing Community notice boards	UNOPS Social and Environmental Safeguards Specialists; UNOPS Engineer	Minutes of meeting Messages produced for notice boards
	Information on construction	2 weeks before entrance of contractor – Meeting with local headmen, DMC members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc. – with social distancing	UNOPS Social and Environmental Safeguards Specialists; UNOPS Engineer; Constructor	Minutes of meeting

Information Dissemination during remedial works	ESMP	Community meetings with local headmen, DMC, District Disaster Committee, community members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc. – with social distancing Community notice boards Radio announcement / broadcast Email / website – national level stakeholders	UNOPS Social Safeguards Specialist	Minutes of meeting Messages produced for notice boards Message sent to radio broadcaster Email message, website
	Any works-related information (on activities, details of construction activities, labor)	Community meetings with local headmen, DMC, District Disaster Committee, community members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc. – with social distancing Community notice boards	UNOPS Social and Environmental Safeguards Specialists; UNOPS Engineer; Constructor	Minutes of meeting Messages produced for notice boards
	GRM	Community meetings with local headmen, DMC, District Disaster Committee, community members – with social distancing Community notice boards Radio announcement / broadcast Email – national level stakeholders	IDSP Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message
Information Dissemination in regards to the long term use	GRM	Community Meetings – with social distancing Community Notice Boards	DMC; District Disaster Response Team; local headmen	Minutes of meeting Messages produced for notice boards
	Information on dam safety concerns	Community Meetings – with social distancing Community Notice Boards	DMC; District Disaster Response Team; local headmen	Minutes of meeting Messages produced for notice boards

9.4 Stakeholder Consultation Plan

In addition to information dissemination, the sub-project will ensure consultations of PAPs in view of all sub-project activities, including environmental and social aspects. Consultations will mainly take place through community meetings. The GRM will be another means of consultation, as complaints received will be filed, assessed and responded to (see separate document).

Consultations during ESMP preparation

Project stage	Topic of consultation	Suggested Method	Target stakeholders	Responsibilities
Consultations prior to remedial works about the immediate dam safety concerns	Overall sub-project activities / E&S mitigation measures	Community meetings – with social distancing	Community level stakeholders, including vulnerable groups	UNOPS
		Meetings with women's groups of other vulnerable groups – with social distancing	Vulnerable community members	UNOPS
		Consultation meetings with local headmen, DMC and district authorities	local headmen, DMC and district authorities	UNOPS

Consultations planned for the implementation stage

Project stage	Topic of consultation	Suggested Method	Target stakeholders	Responsibilities
Consultations during remedial works	Sub-project Activities / E&S Mitigation Measures ESMP Disclosure	Community meetings (all interested community members)	Community level stakeholders	UNOPS
		Suggestion Box at district office, school, church	Community members, including vulnerable groups	IDSP Social Specialist
		Stakeholder meetings – with social distancing	DMC and district level stakeholders	UNOPS
		email	National level stakeholders	UNOPS
			All stakeholders, including vulnerable groups	IDSP Social Specialist

	Venue: community meeting venue in the village or the school District council hall Time: to be agreed with the community and other stakeholders After document clearance and before construction works commence	DMC, local headmen, and District Disaster Committee to receive feedback in person	Community level stakeholders, including vulnerable groups	IDSP Social Specialist
		email	National level stakeholders	UNOPS

9.5 Proposed Strategy to incorporate the Views of Vulnerable Groups

UNOPS and IDSP will ensure that women, persons with disabilities, other members of vulnerable groups are participating effectively and meaningfully in consultative processes and that their voices are not ignored. This may require specific measures and assistance to afford opportunities for meetings with vulnerable groups in addition to general community consultations. For example, women may be more outspoken in women-only consultation meetings than in general community meetings. Similarly, separate meetings may be held with young people, persons with disabilities. Further, it is important to rely on other consultation methods as well, which do not require physical participation in meetings, such as social media, SMS, or radio broadcasting, to ensure that groups that cannot physically be present at meetings can participate.

In view of promoting gender equality, it is most important to engage women's groups on an ongoing basis throughout the lifetime of the sub-project. Women voicing their concerns and contributing in the decision-making process on issues such as community infrastructure should be encouraged, especially in various fora that predominantly consist of men.

GRMs are designed in such a way that all groups identified as vulnerable have access to the information and can submit their grievances and receive feedback as prescribed.

9.6 Reviews of Comments

IDSP will gather all comments and inputs originating from community meetings, suggestion boxes, GRM outcomes, and surveys. The information gathered will be submitted to the Social Specialist in the PIU, to ensure that the sub-project has general information on the perception of communities, and that it remains on target. It will be the responsibility of IDSP respectively to respond to comments and inputs, and to keep open a feedback line to the communities, as well as the local authorities. This SEP provides the overarching guidelines for the rolling out of stakeholder engagements.

10 ESMP Implementation Process

Step 1: Procurement and Bidding Process

Based on this ESMP and the designs for the Makaba Dam works, UNOPS will prepare bidding documentation to procure a contractor to implement the project works at the Makaba dam site. Specifications for environmental and social safeguards derived from the ESA and the ESMP will be included in the tender documents. Bidders receive key documentation outlining the requirements of the ESMP, as well as UNOPS Health & Safety requirements (see UNOPS Health & Safety Management Plan). The bidding documents will contain a general reference to the necessity to comply with this ESMP and will detail key tasks/mitigation measures/trainings, which the contractor will be obliged to undertake as part of his deliverables. These will include the required contractor's plans, COCs for workers, reference to workers' GRM the contractor will need to provide, compulsory workers and community trainings the contractor needs to implement. The bidding documents will contain requests for a detailed budget from the contractor for the implementation of all necessary actions to comply with this ESMP and specifically risk/impact mitigation measures laid out.

Step 2: Contractor Management

UNOPS will contract the contractor. The selected contractor will comply with all stipulations in this ESMP for the duration of the contract. These requirements equally apply to sub-contractors. It is the contractor's responsibility to ensure that sub-contractors comply and demonstrate such compliance in submittals and during verification processes by UNOPS. The contractor will engage competent health, safety, social and environmental staff on site to carry out environmental and social mitigation measures set out in the ESMP. The officer will be responsible for implementation and monitoring the contractor‘s compliance with the ESMP requirements and the environmental specifications.

The duties of the officer will include but not be limited to the following: a) carry out health, safety, social and environmental site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to pollution control and adequacy of environmental mitigation measures implemented; b) monitor compliance with mitigation and protection measures, pollution prevention and control measures and contractual requirements; c) monitor the implementation of environmental mitigation measures; d) prepare monthly status reports for the site environmental conditions; e) advise the contractor on health, safety, social and environment improvement, awareness and proactive pollution prevention measures; d) recommend suitable mitigation measures to the contractor in the case of noncompliance; e) carry out additional monitoring of noncompliance instructed by the supervisor; f) inform the contractor and supervisor of environmental issues, submit contractor's plans to the supervisor and relevant authorities, if required; and g) keep detailed records of all site activities that may relate to health, safety, social and environment.

If pre-bid meetings, site visits and / or contract commencement meetings are carried out, the social & environmental and health & safety requirements and submittals should be discussed, both for day-to-day work and for social and environmentally critical stages or activities.

- E&S/GBV Codes of Conduct are required of contractors and subcontractors and their workers (equivalent to sample in appendix C);
- Contractors provide details on contractor's oversight on environmental, social, health and safety performance;
- Contractor and sub-contractors to deploy a workers' grievance mechanism to handle the concerns

of their workers;

- Contractor will prepare and affirm all plans and method statements required in this ESMP prior to construction activities
- Borrow pits and material sites
- Contractor emergency response plan
- Waste management
- Campsite activities
- Excavation works and stock piling
- Sanitation and water management
- Traffic management and access routes management
- Biodiversity management
- Signage design and plan
- Training, engagement and sensitization

- Contractor will comply with the legislative requirements and standards
- Contractor will carry out any corrective actions instructed by UNOPS and IDSP. In case of non-compliances/discrepancies, the contractor will carry out investigation and submit proposals on mitigation measures and implement remedial measures to reduce environmental impact.
- Non-compliance by the contractor may cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of UNOPS.

Step 3: Monitoring and Reporting Structures

UNOPS and IDSP will assign qualified and experienced environmental and social experts, as defined in the above section on Institutional Arrangements. They will be responsible for routine supervising and monitoring all construction activities and for ensuring that contractor complies with the requirements of the contract.

- UNOPS will be responsible for and will oversee, supervise and monitor the works of the contractor, including the contractor's E&S performance.
- UNOPS will ensure regular supervision and monitoring of the implementation of all E&S mitigation measures laid out in this ESMP, as well as all trainings and other required activities.
- UNOPS will use the indicators all mitigation measures, as listed above in this ESMP, for its monitoring activities.
- A supervision and monitoring report will be prepared every month and shared with the PIU of ISDP and the World Bank. The contents of this report will include: progress of the civil works, implementation of the ESMP, confirmed the supervision of environmental and social specialist on site, photos records of works, camp areas, use of PPE, waste management, restoration efforts, grievances, accidents, communication, and training, among others.
- UNOPS will monitor and review all method statements prepared by the contractor to ensure that all areas that require remediation/ rehabilitation are covered and that the proposed methodologies are appropriate.
- UNOPS will take measures in the case of non-compliance. It will immediately liaise with the contractor, assess the risk level, significant and severe risks will cause for suspension of works until the non-compliance has been resolved to the satisfaction of UNOPS. Any significant loss of time caused by the contractor's non-compliance situations will be dealt with in accordance with the set procedures in the contract.

The contractor must report on all HSSE matters related to this ESMP to UNOPS on a monthly basis. UNOPS will administer the monthly reports from the contractor, and will prepare its own quarterly reports, based on its supervision and monitoring activities, as well as designated UNOPS activities in this ESMP to IDSP. Quarterly progress reports will include the status of the implementation of risk mitigation measures, trainings, workers' GRM, as well as lessons learnt, any adjustments made to improve E&S management and performance and corrective actions undertaken, if applicable. Quarterly reports will also be made available to the local DMC and local authorities. The monitoring roles and responsibilities of the key parties/ stakeholders regarding the implementation of the ESMP will be communicated to relevant ministries indicated.

IDSP will implement its own monitoring and supervision activities as they apply for all AF activities, including the remediation of Makaba Dam. IDSP has the overall responsibility for monitoring and reporting, but is supported by UNOPS' monitoring and quality assurance activities. IDSP and UNOPS will jointly discuss any necessary amendments to activities, where necessary.

Step 4: Incident Reporting

The Contractor, UNOPS, and IDSP are required to report on any incidents related to the sub-project activities. The contractor will form the incident investigation team and will provide incident reporting on a monthly basis to UNOPS, and UNOPs will include summaries of incidents in its regular reporting to IDSP. Any incidents classified as 'severe' must be reported to the World Bank within 48 hours.

Incident reporting will follow the management and reporting process in Figure 36:

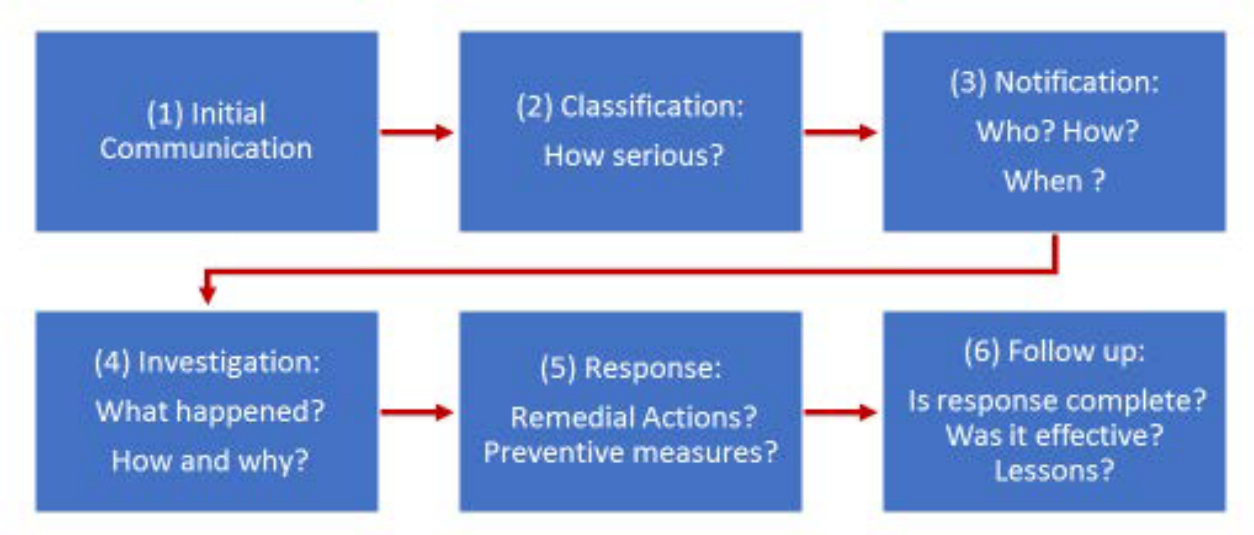


Figure 34: Incident reporting process

Incidents should be categorized into 'indicative', 'serious' and 'severe' (see Appendix G for World Bank classification of incidents).

- 'Indicative' incidents are minor, small or localized that negatively impact a small geographical area or a small number of people and do not result in irreparable harm to people or the environment.
- A 'significant' incident is one that causes significant harm to the environment, workers, communities, or natural resources and is complex or costly to reverse (see below for World Bank incident classification guide).
- A 'severe' incident causes great harm to individuals, or the environment, or presents significant

reputational risks to the World Bank. Incident reports should use the format in Appendix G.

Severe incidents (an incident *that caused significant adverse effect on the environment, the affected communities, the public or workers*, e.g. fatality, GBV, forced or child labor) will be reported within 48 to UNOPS, IDSP and the World Bank.

Step 5: Handover for Operation

Once construction works and trainings are completed, UNOPS and IDSP will declare the works final. The dam will be handed over to the Makaba DMC, which is part of the local community and local authorities.

Remedial actions that cannot be effectively carried out during construction must be carried out on completion of the works and before issuance of the acceptance of completion. UNOPS will be responsible for accepting the final works from the contractor and receiving approvals from IDSP. IDSP will manage the handover to the local entities and ensure that the dam communities have all capacities necessary to manage the dam. IDSP will be continually engaging with the communities and local authorities until the end of its lifespan.

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Appendix A: Completed Checklist

IDENTIFICATION OF ENVIRONMENTAL AND SOCIAL RISKS RELATED TO THE REMEDIATION OF TEN - LEGACY DAM - IN ZAMBIA: Makaba Dam

1-Date of the visit: 15th July 2020		
Name of the Environmental Specialist filling this checklist: Pilila Chongo		
Job Position: HSSE Analyst		
Have completed training in the Environmental and Social Safeguards of the World Bank: Yes / No…Yes		
Have read the Environmental and Social Audit report and the ISDS prepared for the Additional Financing of the project: Yes / No…a Yes		
Have you read the information available of this dam: Yes / No…Yes		
Note: if you marked No in any of these questions, you are not ready to fill this checklist. Please coordinate with the PIU team to provide you with these reports.		
2-Information about the Dam		
Name of the Dam: Makaba Dam		
Location Namwala	**Region** Southern Province	**District** Namwala
Villages /communities	Makaba	
Geographical location	**Coordinate South** 16° 5'59.92"S	**Coordinate East** 26°51'19.67"E
3-Remediation works- please indicate the main proposed works that could cause environmental and social impacts		
Slope works	Material sourcing	Access routes
Outlets	Erosion/ soil loosening	Spillway
Infiltration	Site preparations/ clearing	Irrigation canal

Other	Waste management	

4.MATERIALS NEEDED		
Does the project need aggregate or a new borrow pit	Yes	
Indicate potential sources to buy or extract the construction materials:	Within the Community	
Aggregates	Within the Community	
Sand/ clay	Within the Community	
Wood	Not Applicable	
Diesel for transportation	Namwala/Choma Town	
Water source for the construction	Within the Community	
Water source for drinking for workers	Within the Community	

Contractors/builders		, and Namwala Town
Estimated Number of workers to be hired for the construction works 15		**Who will pay in case of accidents or fatal accidents ……**The Contractor
Who will hire the workers	The Contractor	
Insurance provided to the workers	**Yes** □□ No □□Are contractors registered in Zambia in case compensations for accidents are needed	
		Contractor not yet engaged

5-General environmental conditions		
Is the dam is located within a protected area, KBA, or other sensitive location?	Yes □ **No** □□	Name of the protected area:
What are the conditions of the forest or natural vegetation in the project site	Explain: Disturbed by various anthropogenic activities	

6-Evaluation of impacts and mitigation measures to be included in the ESMP (you can use additional paper)	
Main environmental and social impacts: describe	**Possible mitigation measures**
Vegetation:	Re vegetation of slopes, open sites and around the Dam Minimized disturbance of forest cover
Will the construction works needs to cut trees	**Yes** X□ No □o
If the project needs to cut trees – the project will need to plant 3 trees per 1 tree cut	Indicate local native species and fruit species that the contractor will need to plant Location Number of trees Access route and material sourcing areas- 3 trees per cut tree

Water:	Maintain water quality during works and minimize further siltation in the basin Construct VIP toilet an safely decommission
Roads:	Rehabilitate roads after works Promote community health and safety
Safety	Erect safety signage, sensitize the communities, minimize public health threats
Hazardous waste	Storage in concrete bund without an outlet to the environment. Collection of any spillages. Approved disposal method.
Other:	

7-LEGACY ISSUES /REMEDIATION	
PLEASE INDICATE. Any of these legacy issues that are environmental legacies that need to be resolved by the project, costed and included in the contract of contractors. recommend measures so the engineering team can include them in the remediation plans.	
Legacies	**Measures to be included in the ESMP**
o **Solid waste (Wood, plastic, etc)**	-
o **Hazardous wastes (diesel containers, old machinery, batteries, paints, metals, contaminated waters or soil,**	-

o **Borrow pits**	Decommissioning and rehabilitation of one borrow pit
o **Unsafe paths**	Rehabilitation of former contractor roads Construction of crossing
o **Unfinished crossing points for communities**	Crossing point over the spillway and embankment is not safe Construction of animal watering points around the basin
o **Other: Environmental flows and outlets**	Inclusion of outlets, flow monitoring gauges, rehabilitation of seepage points
8- Ecological Flow. Have you to coordinate with the technical team the options to improve ecological flows below the dams Yes No (you need to coordinate) Yes	
What is the flow below the dam (m^3/s)	To be confirmed-
Are wetlands below the dam No	**Are critical species present in the wetland or rivers: Yes (indicate below species)** The initial assessment using IBAT indicates presence of species that may be endangered or may require special attention. The full biodiversity assessment was conducted and a BMP developed, annexed to this ESMP
Are people using the water below the dam? What for?	Not all year round. Only in rain season when there are downstream flows
Based on these findings, please indicate if it is possible to install a structural solution to improve the ecological flow **No** **Explain:**	**Yes Explain:** Though inlet flows upstream are low in the dry months **Structural measures** Outlets, gauges, spillway rehab **Operational measures** Flow measurements, training
9) Biodiversity. It is expected that you performed survey to the area or collect data with experts on diversity of the area for each dam. Please indicate what groups have been investigated in the project area and preliminary observations. **(Refer to the BMP)**	
Plants	Mammals

Fish	Amphibians
Macroinvertebrates	Other groups
Please indicate issues of poaching, illegal trade, and other issues affecting the area	
Presence of sensitive species:	
Critically Endangered species:	**Endangered species:**
Vulnerable species	**Migratory species:**
Protected species in Zambia:	**Endemic/rare/globally important species:**
Based on the results of the field observation, data collected and the OP 4.04 definitions	This project has natural habitat YES / NO The project area has critical habitats YES /NO
Based on the project area and the risk and potential impacts, you have identified for biodiversity –	

1-Please indicate the recommend measures to protect these species and Prepare in a separate document a Biodiversity Action Plan (BAP) **2.In the area contains critical habitat and there is ecological flow needs please request to Prepare in a separate document as a Biodiversity and Ecological Management Plan (BEMP)**	
10-Final recommendation	
Name Pilila Chongo,	**Date: 22 July 2020**
Signature P.C	
Comments for the preparation of the ESMP and BAP incl. Ecological flow measures. Detailed environmental and social studies and inclusion of such matters in the designs. Further Ecological surveys **have been conducted and placed in the annexed BMP** *This section will be updated after the Biodiversity Assessment*	
Field visits registration	
Photo **Eroded spillway channel and broken canal**	Photo ' **Spillway Gullied**

Photo
Spillway channel training wall repaired by the local community

Appendix B: Chance Find Procedures

This procedure was developed to protect and preserve both tangible and intangible cultural heritage records of Zambia. This procedure is included as a standard provision in the implementation of sub-project public works contracts to ensure the protection of cultural heritage (archaeological and historical sites). All contractors as well as sub-contractors and implementers will be required to observe this procedure as documented hereafter.

Excavation in sites of known archaeological interest will not be allowed under this sub-project. Where historical remains, antiquity or any other object of cultural or archaeological importance are unexpectedly discovered during construction in an area not previously known for its archaeological interest, the following procedures should be applied:

- Stop construction activities;
- Delineate the discovered site area;
- Secure the site to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive remains, a full-time guard should be present until the responsible authority takes over;
- Notify the responsible foreman/archaeologist, who in turn should notify the responsible authorities (Ministry of Tourisms and Arts), the concerned governmental officers and local authorities (within less than 24 hours);
- Responsible authorities are in charge of protecting and preserving the site before deciding on the proper procedures to be carried out;
- An evaluation of the finding will be performed by the concerned officers from the Ministry of Tourism and Arts. The significance and importance of the findings will be assessed according to various criteria relevant to cultural heritage including aesthetic, historic, scientific or research, social and economic values;
- Decision on how to handle the finding will be reached based on the above assessment and could include changes in the sub-project layout (in case of finding an irrevocable remain of cultural or archaeological importance), conservation, preservation, restoration or salvage;
- Implementation of the authority decision concerning the management of the finding;
- Construction work can resume only when permission is given from the Ministry of Tourism and Arts after the decision concerning the safeguard of the heritage is fully executed;
- In case of delay incurred in direct relation to archaeological findings not stipulated in the contract (and affecting the overall schedule of works), the contractor may apply for an extension of time. However, the contractor will not be entitled for any kind of compensation or claim other than what is directly related to the execution of the archaeological findings works and protections.

Appendix C: Sample Code of Conduct for Workers

United Nations Charter: The values enshrined in the United Nations (UN) Charter, *respect for fundamental human rights, social justice and human dignity, and respect for the equal rights of men and women*, serve as overarching values to which suppliers of goods and services to the UN1 are expected to adhere.

Global Compact: The Global Compact is a voluntary international corporate citizenship network initiated to support the participation of both the private sector and other social actors to advance responsible corporate citizenship and universal social and environmental principles to meet the challenges of globalization. The UN strongly encourages all suppliers to actively participate in the Global Compact. And to that end, this Code of Conduct has been developed with recognition of the importance of the ten principles of the UN Global Compact and is viewed as an important means of integrating the Compact into the operations of the UN. The Code of Conduct addresses the issues included in the Compact in the areas of human rights, labor, environment and anti-corruption and interpretation of the Code should be undertaken in a manner consistent with the Global Compact. Suppliers interested in supporting the Global Compact and obtaining more information on the ten principles, can visit the Global Compact website at www.unglobalcompact.org.

International Labor Conventions and Recommendations: The International Labor Standards (i.e., Conventions and Recommendations) as established by the tripartite UN specialized agency, the International Labor Organization (ILO), have served as the foundation on which much of this Code of Conduct is based. It is the UN´s expectation that any supplier providing products or services to the UN will, in addition to the values of the UN Charter, adhere to the principles concerning International Labor Standards summarized below in paragraphs 4 – 9.2

1. Scope of Application:
The UN expects that these principles apply to suppliers and their employees, parent, subsidiary or affiliate entities and subcontractors. The UN expects suppliers to ensure that this Code of Conduct is communicated to their employees, parent, subsidiary and affiliated entities as well as any subcontractors, and that it is done in the local language and in a manner that is understood by all. In order for a supplier to be registered as a UN supplier or to do business with the UN, the supplier is required to read and acknowledge that this Code of Conduct provides the minimum standards expected of UN Suppliers. In addition, suppliers should note that certain provisions of this Code of Conduct will be binding on the supplier in the event the supplier is awarded a contract by the UN pursuant to the terms and conditions of any such contract. Failure to comply with certain provisions may also preclude suppliers from being eligible for a contract award, as reflected in the solicitation documents of one or more organizations in the UN. Prospective suppliers are invited to review the specific terms and conditions of contract and procurement policies of the organization(s) within the UN with which they would like to do business in order to ascertain their current and future eligibility.

2. Continuous Improvement:
The provisions as set forth in this Code of Conduct provide the minimum standards expected of suppliers to the UN. The UN expects suppliers to strive to exceed both international and industry best practices. The UN also expects that its suppliers encourage and work with their own suppliers and subcontractors to ensure that they also strive to meet the principles of this Code of Conduct. The UN recognizes that reaching some of the standards established in this Code of Conduct is a dynamic rather than static process and encourages suppliers to continually improve their workplace conditions accordingly.

3.Management, Monitoring and Evaluation:
It is the expectation of the UN that its suppliers, at a minimum, have established clear goals toward meeting the standards set forth in this Code of Conduct. The UN expects that its suppliers will establish and maintain appropriate management systems related to the content of this Code of Conduct, and that they actively review, monitor and modify their management processes and business operations to ensure they align with the principles set forth in this Code of Conduct. Supplier participants in the Global Compact are strongly encouraged to operationalize its principles and to communicate their progress annually to stakeholders.
Labour:

4. Freedom of Association and Collective Bargaining: The UN expects its suppliers to recognize the freely-exercised right of workers, without distinction, to organize, further and defend their interests and to bargain collectively, as well as to protect those workers from any action or other form of discrimination related to the exercise of their right to organize, to carry out trade union activities and to bargain collectively.

5. Forced or Compulsory Labor: The UN expects its suppliers to prohibit forced or compulsory labor in all its forms.

6. Child Labor: The UN expects its suppliers not to employ: (a) children below 14 years of age or, if higher than that age, the minimum age of employment permitted by the law of the country or countries where the performance, in whole or in part, of a contract takes place, or the age of the end of compulsory schooling in that country or countries, whichever is higher; and (b) persons under the age of 18 for work that, by its nature or the circumstances in which it is carried out, is likely to harm the health, safety or morals of such persons.

7. Discrimination: The UN expects its suppliers to ensure equality of opportunity and treatment in respect to employment and occupation without discrimination on grounds of race, colour, sex, religion, political opinion, national extraction or social origin and such other ground as may be recognized under the national law of the country or countries where the performance, in whole or in part, of a contract takes place. The UN expects its suppliers to take all appropriate measures to ensure that neither themselves nor their parent, subsidiary, affiliate entities or their subcontractors are engaged in any gender-based or other discriminatory employment practices, including those relating to recruitment, promotion, training, remuneration and benefits.

8. Wages, Working Hours and Other Conditions of Work: The UN expects its suppliers to ensure the payment of wages in legal tender, at regular intervals no longer than one month, in full and directly to the workers concerned. Suppliers should keep an appropriate record of such payments. Deductions from wages are permitted only under conditions and to the extent prescribed by the applicable law, regulations or collective agreement and suppliers should inform the workers concerned of such deductions at the time of each payment. The wages, hours of work and other conditions of work provided by suppliers should be not less favorable than the best conditions prevailing locally (e.g. collective agreements covering a substantial proportion of employers and workers / arbitration awards / applicable laws or regulations) for work of the same character performed in the trade or industry concerned in the area where work is carried out.

9. Health and Safety: The UN expects its suppliers to ensure, so far as is reasonably practicable, that: (a)

the workplaces, machinery, equipment and processes under their control are safe and without risk to health; (b) the chemical, physical and biological substances and agents under their control are without risk to health when the appropriate measures of protection are taken; and (c) where necessary, adequate protective clothing and protective equipment are provided to prevent, so far as is reasonably practicable, risk of accidents or of adverse effects to health.

Human Rights:

10. Human Rights: The UN expects its suppliers to support and respect the protection of internationally proclaimed human rights and to ensure that they are not complicit in human rights abuses.

11. Harassment, Harsh or Inhumane Treatment: The UN expects its suppliers to create and maintain an environment that treats all employees with dignity and respect. The UN further expects that its suppliers, as well as their parent, subsidiary and affiliated entities along with any subcontractors, will neither use or engage in, nor allow their employees or other persons engaged by them to use or engage in, any: threats of violence, verbal or psychological harassment or abuse, and/or sexual exploitation and abuse. Sexual exploitation and abuse violate universally recognized international legal norms and standards and have always been unacceptable behavior and prohibited conduct for the UN. Prior to entering into agreements with the UN, suppliers are informed of the standards of conduct with respect to the prohibition of sexual exploitation and abuse, expected by the UN. Such standards include, but are not limited to, the prohibition of: (i) engaging in any sexual activity with any person under the age of 18, regardless of any laws of majority or consent, (ii) exchanging any money, employment, goods, services, or other things of value, for sex, and/or (iii) engaging in any sexual activity that is exploitive or degrading to any person. The UN expects its suppliers to take all appropriate measures to prohibit their employees or other persons engaged by the suppliers, from engaging in sexual exploitation and abuse. The UN also expects its suppliers to create and maintain an environment that prevents sexual exploitation and abuse. United Nations contracts will contain provisions concerning a supplier´s obligation to take appropriate measures to prevent sexual exploitation and abuse. The failure by a supplier to take preventive measures against sexual exploitation or abuse, to investigate allegations thereof, or to take corrective action when sexual exploitation or abuse has occurred, constitute grounds for termination of any agreement with the United Nations. Moreover, no harsh or inhumane treatment coercion or corporal punishment of any kind is tolerated, nor is there to be the threat of any such treatment.

12. Mines: The UN expects its suppliers not to engage in the sale or manufacture of anti-personnel mines or components utilized in the manufacture of anti-personnel mines.

Environment:

13. Environmental: The UN expects its suppliers to have an effective environmental policy and to comply with existing legislation and regulations regarding the protection of the environment. Suppliers should wherever possible support a precautionary approach to environmental matters, undertake initiatives to promote greater environmental responsibility and encourage the diffusion of environmentally friendly technologies implementing sound life-cycle practices.

14. Chemical and Hazardous Materials: Chemical and other materials posing a hazard if released into the environment are to be identified and managed to ensure their safe handling, movement, storage, recycling or reuse and disposal.

15. Wastewater and Solid Waste: Wastewater and solid waste generated from operations, industrial processes and sanitation facilities are to be monitored, controlled and treated as required prior to discharge or disposal**.**

16. Air Emissions: Air emissions of volatile organic chemicals, aerosols, corrosives, particulates, ozone depleting chemicals and combustion by-products generated from operations are to be characterized, monitored, controlled and treated as required prior to discharge or disposal.

17. Minimize Waste, Maximize Recycling: Waste of all types, including water and energy, are to be reduced or eliminated at the source or by practices such as modifying production, maintenance and facility processes, materials substitution, conservation, recycling and re-using materials.

Ethical conduct:

18. Corruption: The UN expects its suppliers to adhere to the highest standards of moral and ethical conduct, to respect local laws and not engage in any form of corrupt practices, including but not limited to extortion, fraud or bribery.

19. Conflict of Interest: UN suppliers are expected to disclose to the UN any situation that may appear as a conflict of interest, and disclose to the UN if any UN official or professional under contract with the UN may have an interest of any kind in the supplier's business or any kind of economic ties with the supplier.

20. Gifts and Hospitality: The UN will not accept any invitations to sporting or cultural events, offers of holidays or other recreational trips, transportation, or invitations to lunches or dinners. The UN expects its suppliers not to offer any benefit such as free goods or services, employment or sales opportunity to a UN staff member in order to facilitate the suppliers´ business with the UN.

21. Post-employment restrictions: Post-employment restrictions may apply to UN staff in service and former UN staff members who participated in the procurement process, if such persons had prior professional dealings with suppliers. UN suppliers are expected to refrain from offering employment to any such person for a period of one year following separation from service.

Appendix D: Managing COVID-19 Risks

UNOPS Guidelines for Construction Sites[32]

These requirements should be mandatory for UNOPS and all contractors, they should be issued in a formal, written instruction to the contractor using the template provided below.

Requirements: Construction sites should be treated like offices, with the following steps to be discussed with the Contractor and enforced by the UNOPS site supervisor.

General

1. Ensure that the people meeting the following criteria will not come to site:
    - any personnel showing symptoms of coughing, difficulty in breathing, fever, tiredness, aches and pains, nasal congestion, runny nose, sore throat or diarrhea, until a medical certificate is provided;
    - vulnerable persons (by virtue of their age, underlying health condition, clinical condition or are pregnant)
    - any person living with someone in self-isolation or a vulnerable person.
2. In the case that a worker is detected with COVID-19 the site will be closed and workers in contact with the individual will be required to self-isolate for 14 days until medical all-clear is granted.
3. Social distancing of at least 1 meter should be maintained at all times between personnel. Handshakes, hugs and other close contact interactions are therefore prohibited on site.
4. Hand washing station posted at the site entrance, with soap for all workers and people entering the site, and additional stations at locations in the site that make it possible for workers to frequently wash their hands. Hand sanitizers should be provided where hand washing facilities are unavailable to point.
5. A focal point to implement and monitor prevention measures should be designated.
6. No masks are needed on site for work unless hazardous materials are being used.
7. In case of any infringements, UNOPS will stop work of the contractor and delays that incur penalties will be the responsibility of the contractor.
8. UNOPS will refuse access to the site to any individuals seen breaking the hygiene protocols and may require the contractor to stop all works immediately.
9. UNOPS must cooperate with the Zambia country directives in response to the COVID-19 pandemic.
10. All cases should be reported to UNOPS as soon as detected, as well as to local health authorities.
11. These protocols are to be recorded as part of the HSSE requirements for the site.

Travel to sites

12. Wherever possible, workers should travel to site alone using their own transport.
13. Risk assessments should be used to determine the risks for local travel to sub-project sites and precautionary measures should be applied if these are deemed necessary.
14. Sites need to consider:
    - Parking arrangements for additional cars and bicycles

[32] This document was developed by field personnel and added to by construction personnel all over UNOPS. It should continue to be commented on by everyone, as we understand more about the virus and think of better ways to protect.

- Other means of transport to avoid public transport e.g. cycling
- How someone taken ill would get home.

Site Access Points

15. Focal point appointed by UNOPS or the contractor, with the site supervisor, will check the temperature and ensure hand washing prior to site entry of all personnel.
    - Focal point should have a thermometer to do so.
    - For larger sites, a nurse or medical staff may be provided, however, the goal is not to treat personnel who may have COVID-19, but identify any symptoms and ensure personnel are immediately removed from the site.
16. Focal point should ask the following questions to the staff:
    - Have you had a fever or other symptoms of the COVID-19 in the past 2 weeks?
    - Is there anyone in your household who has the symptoms or is ill with COVID-19?
    - Is there any person in your neighborhood or community who has been diagnosed with COVID-19?
    - Have you been abroad or in contact with travelers from different countries?
17. Ensure personnel wash or clean their hands before entering or leaving the site.
18. Stop all non-essential visitors.
19. Introduce staggered start and finish times to reduce congestion and contact at all time, if possible. Take into consideration appropriate timings for men and women, according to their other responsibilities. If there are fewer workers on sites ensure safety of female workers from sexual harassment (PSEA issues).
20. Monitor site access points to enable social distancing – site supervisor may need to change the number of access points, either increase to reduce congestion or decrease to enable monitoring.
21. Remove or disable entry systems that require skin contact e.g. fingerprint scanners
22. Reduce the number of people in attendance at site inductions and consider holding them outdoors wherever possible, also ensure 1 meter distance between participants during the inductions.
23. Drivers should remain in their vehicles if the load will allow it and must wash or sanitize their hands before unloading goods and materials.

Communication and awareness

24. Daily briefing on how to prevent exposure to COVID-19 and on the control measures in the site should be delivered.
25. Post posters about proper handwashing and respiratory hygiene at different sub-project sites (work fronts, temporary offices, and the sub-project operations campus)

Canteens and Eating Arrangements

26. Hand washing is enforced before mealtimes.
27. All personnel should be advised to observe safe distances during eating times.
28. All personnel should avoid sharing food and drinks with colleagues
29. The workforce should be asked to bring pre-prepared meals and refillable drinking bottles from home.
30. Site eating areas will be disinfected daily by the contractor.
31. All rubbish should be put straight in the bin and not left for someone else to clear up.
32. Where catering is provided on site, it should provide pre-prepared and wrapped food only. Where possible payment arrangements should be made such there will be no need to exchange money

e.g. contactless cards or pre-arranged monthly payments. Crockery, eating utensils, cups etc. should not be used.

Changing Facilities, Showers and Drying Rooms

33. Introduce staggered start and finish times to reduce congestion and contact at all times. Take into consideration appropriate timings for men and women, according to their other responsibilities.
34. Consider increasing the number or size of facilities available on site if possible.

Avoiding Close Working

There will be situations where it is not possible or safe for workers to distance themselves from each other by 1 meter. The following general principles should be applied:

35. Safety critical work should still be carried out with adequate personnel and under adequate levels of supervision to avoid incidents that may lead to loss of life.
36. Non-essential physical work that requires close contact between workers should not be carried out.
37. Work requiring skin to skin contact should not be carried out.
38. Plan all other work to minimize contact between workers.
39. Establish working groups to minimize the movement of people in the sub-project area to facilitate traceability and control, in case any possible contagion is identified.
40. Re-usable PPE should be thoroughly cleaned after use and not shared between workers. Ensure that female workers are given PPE purposefully designed for women.
41. Single use PPE should be disposed of so that it cannot be reused.
42. Stairs should be used in preference to lifts or hoists.
43. Increase ventilation in enclosed spaces.
44. Regularly clean the inside of vehicle cabs and between use by different operators.

Site Meetings

45. Only absolutely necessary meeting participants should attend.
46. Attendees should be 1 meter apart from each other.
47. Rooms should be well ventilated / windows opened to allow fresh air circulation.
48. Consider holding meetings in open areas where possible.

Cleaning

49. Enhanced cleaning procedures should be in place across the site, particularly in communal areas and at touch points including:
    - Taps and washing facilities
    - Toilet flush and seats
    - Door handles and push plates
    - Hand rails on staircases and corridors
    - Lift and hoist controls
    - Machinery and equipment controls
    - Food preparation and eating surfaces
    - Telephone equipment
    - Key boards, photocopiers and other office equipment
50. Rubbish collection and storage points should be increased and emptied regularly throughout and at the end of each day
51. Hired vehicle vendors should be informed to sanitize the interior of their vehicles daily. Drivers to be informed about the preventive measures as well.

52. Personnel using motorbikes should also sanitize the areas of the bike most touched.

Procedure in case of contagion

Any worker with symptoms of the COVID-19 should:

- Notify the supervisor that he/she is not fit to work
- Stay home for at least 14 days
- Maintain a minimum temperature control twice a day
- Report any person in his/her household of these symptoms and inform the supervisor
- Notify the doctor or health service if symptoms do not disappear or worsen.

Any personnel who is confirmed to be diagnosed with COVID-19 should report to the Health and Safety Advisor and the Manager on the site immediately. The reporting procedure should be in line with the EOI.CSG.2017.02 on Reporting and Management of Health & Safety and Social & Environmental incidents.

UNOPS Construction Site Supervision

Guidance: UNOPS personnel are expected to continue to work with contractors and other site personnel, unless there is a stop work order issued by the government. In the case that UNOPS personnel need to visit home in order to support family / relatives, this is understood and personnel may take leave. The sub-project will, if possible, seek additional UNOPS personnel to cover the gap in supervision, to ensure the quality of work continues to be maintained and that work site safety and COVID-19 procedures are followed.

Field Offices < 6 People and Field Monitoring

Requirements: In the general case that personnel are working and living in the same office, “work from home” is similar / same in terms of people as the office. In this case, personnel may continue to work in the office that they live in, however, “Reduced Contact Work” is advised. For field monitoring this involves:

- Ensure when visiting sub-project sites, physical distancing is maintained.
- Avoid consultations, meetings, gatherings which involve a large number of people, beyond the government advice, both for organizing and being a part of. For essential business requirements, limit the number of people (below 10) ensuring physical distance.
- Minimize travel which requires personnel traveling in a partner's vehicle or vice versa. Ensure adequate measures are taken.
- Any discussions with home owners or contractors are outdoors, at 1 meter distance.
- Offices maintain the same protocols with washing hands prior to entry.

In case travel restrictions involve being restricted from any movement at all, personnel will be encouraged to work from home.

Short monitoring/handover missions (for multiple sites)

- Create clusters of 10/15 sites to visit. Sites should be geographically close and visitable in a one (long) day mission.
- Prepare maps of those clusters of sites, including travel distances.
- Prepare mission timetables with detailed timing for each activity (visit of site A, movement, visit of site B, etc.).
- Ask the contractor to submit pictures and videos of sites ready for handover in a pre-handover evidence folder of the teamdrive shared with the contractor.
- Review submissions in detail and pre-clear the sites ready for handover.
- Coordinate with the client and make precise appointments for handover activities, update the mission timetable according to availability of client’s representatives.

- Arrange cars for standalone trips of our Site Supervisors (cars should be provided with water tanks, soap, sanitizer, PPE, lunchboxes, etc.).
- Brief and debrief our Site Supervisors prior/after each handover mission.

IRRIGATION DEVELOPMENT SUPPORT PROJECT (IDSP)

COVID-19 Response Planning and Monitoring

August 21, 2020

Project Name, P#, and contract #	Contract/ activity	Impact of Corona virus on operation	Action identified	Responsible for Action	Anticipated Impact Colour Coding levels of Risk: High = RED; Substantial = Orange; Moderate = Yellow and Low = Green Likelihood: Highly Likely=HL; Extremely likely=EL; Not likely=NL Timing: Short-term=ST; Mid-Term; Long-Term=LT			
					Description	Level (H, S, M, L)	Likelihood HL/ EL /NL	Timing (ST/ MT/LG)
IDSP								

Appendix E: Template for Conditions of Contract

DIRECTION TO IMPLEMENT HEALTH AND SAFETY MEASURES - COVID 19 EPIDEMIC

Dear Sir
[*insert name of contract*] ("Contract")
This is a Notice served under Sub-Clause xxx of the Contract.
Taking into account the circumstances arising out of the Covid-19 pandemic, the Employer's Representative, hereby, instructs you to implement the Health and Safety measures that are listed in appendix 1 of this notice.
These measures are deemed to be reasonable precautions to maintain the health and safety of the Contractor's Personnel and as such are not additional to your existing obligations under the Contract and will not be considered as a Variation.
The Employer's Representative also reminds the Contractor of its obligations under Sub-Clause 6.16 which states that:

> *In the event of any outbreak of illness of an epidemic nature, the Contractor will comply with and carry out such regulations, orders and requirements as may be made by the Authorities or local medical or sanitary authorities for the purpose of dealing with or overcoming the epidemic.*

The Contractor is required to submit evidence of its compliance with the above health and safety measures by [*insert date*].

Yours faithfully

……
[*Employer's Representative*]
for and on behalf of UNOPS

IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

NAME OF SITE: MAKABA ~~Dam~~ DATE: 15/07/20

NAMWALA OFFICERS

S/N	NAME	GENDER	DESIGNATION	ORGANISATION	CONTACT DETAILS	SIGNATURE
1	LINNIE M. SIKAAZE	F	DSWO	Social Welfare	0977917314	
2	STANLEY BANDA	M	DFO	FORESTRY	0964272880	
3	MARY SAKALA	F	DC	DIST ADMIN	0977670291	
4	DANIEL CHILUNDIKA	M	DFO	FISHERIES	0977247257	

IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

NAME OF SITE: MAKABA DAM DATE: 15/07/20

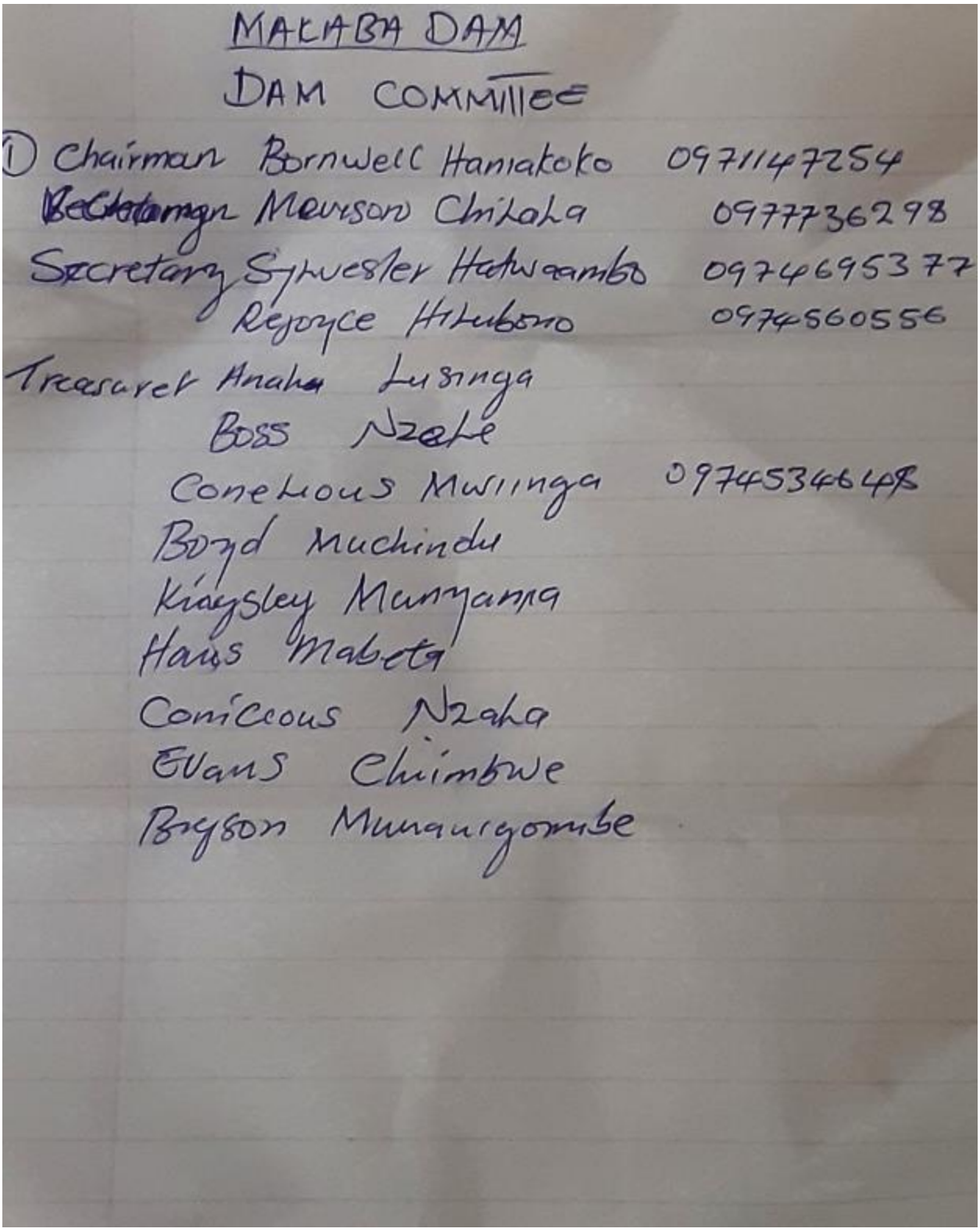
S/N	NAME	GENDER	DESIGNATION	ORGANISATION	CONTACT DETAILS	SIGNATURE
1	Catherine Hamweemba	F	Farmer		0777073102	C.Hamweemba
2	EMELDAH MWAANDAH	F	Farmer		0976463039	Emwaandah
3	MERCY MABETA	F	Famer		0972979756	M.Mabeta
4	Abigail Bubala	F	Famer		–	[illegible]
5	VERONICA HIMOONGA	F	Farmer		0777073912	V.Himoonga
6	Charity milimo	F	Farmer		0955156078	[illegible]
7	Chrisencia Milimo	F	Farmer		0976493475	C.milimo
8	Rodgers Ndhlovu	M	CAC Treasurer		0977852723	[illegible]
9	Ashley CHIYAMBIWE	M	Farmer		0964793614	[illegible]
10	Twiyune HAMPWIDE	M	Fisherman			T.Shweli
11	FERGUS C. CHIIMBWE	M	Head man		0978570323	F.Chiimbwe
12	TREVOR MULOOLO	M	Famer		0972017333	T.Muloolo
13	Dowies Mulungu	M	Farmer		0970608663	D.Mulungu
14	Richwell Hankuko	M	Famer		0978782618	R.Hankako
15	Hatwiimbo Sylvester	m	Dam Secretary		0974695377	[illegible]
16	DZALA JOHN	M	FARMER		~~0974578399~~	J.Dzala
17	HAMBULO DEVINNETTE	M	FARMER		0974457399	D.Hambulo
18	MUWELE Fred	m	FARMER		0976528326	F.Luwle.
19	MEVSON CHILALA	M	CHAIRMAN		0977736298	M.Lala
20	Shelly Kahata	F	Famer		–	S.Kahata
21	MPOOMA OSTER	M	FARMER		0978-392199	[illegible]

IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

NAME OF SITE..... MAICABA DAM .....DATE..... 15/07/20 .....

S/N	NAME	GENDER	DESIGNATION	ORGANISATION	CONTACT DETAILS	SIGNATURE
22	MARETA GEORGE	M	FARMER		0972-072661	
23	BEST HAANKAKO	M	FARMER			Best

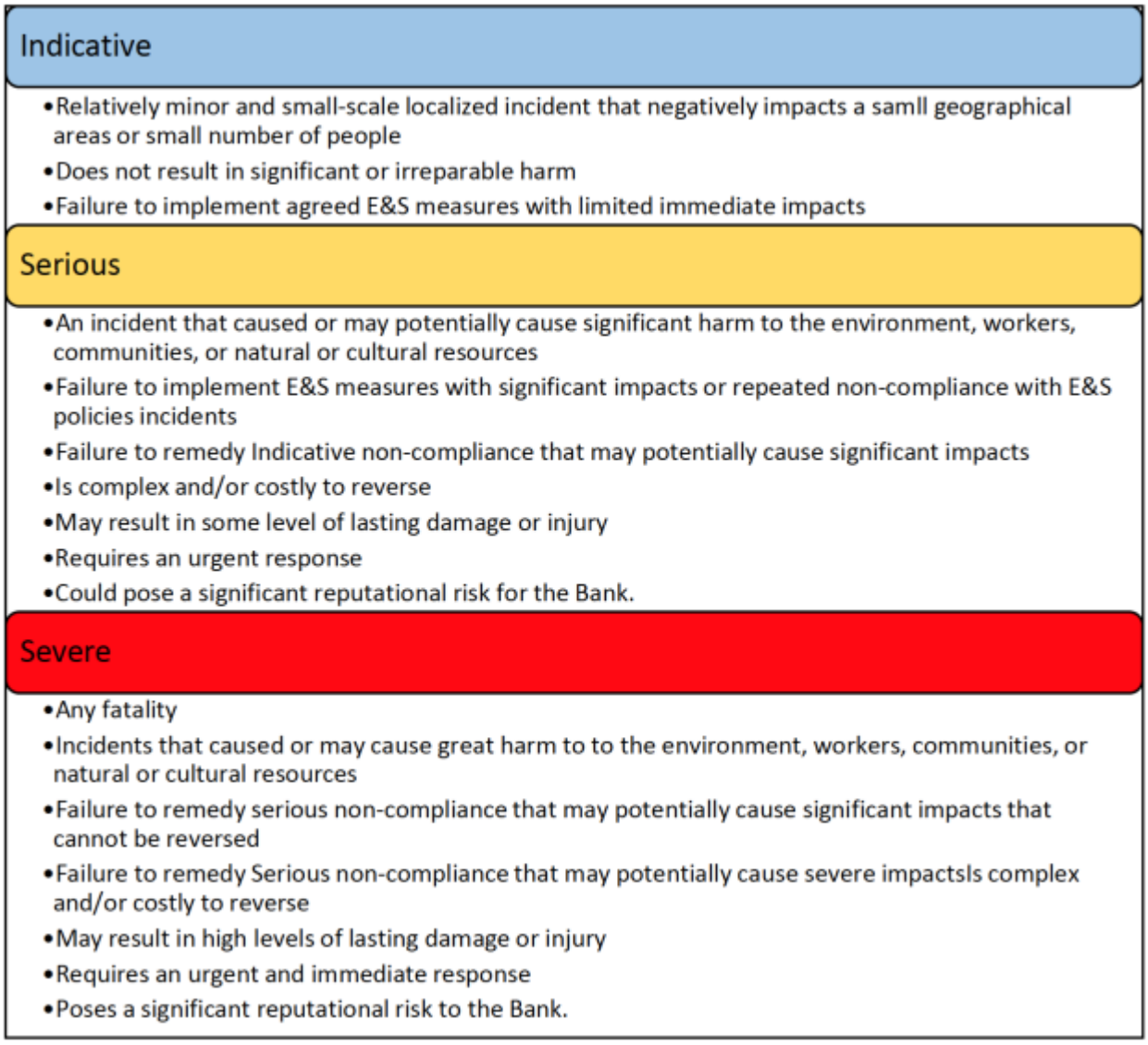


MALABA DAM

DAM COMMITTEE

1. Chairman Bornwell Haniakoko 0971147254
   Vice Chairman Morrison Chilala 0977736298
   Secretary Sylvester Hatwaambo 0974695377
   Rejoyce Hikubono 0974560556
   Treasurer Anaka Lusinga
   Boss Nzale
   Conelious Mwiinga 0974534648
   Boyd Muchindu
   Kingsley Munyanga
   Hans Mabeta
   Conicous Nzala
   Evans Chimbwe
   Bryson Munangombe

Appendix G: World Bank Incident Classification Guide and Incident Report Form



An incident report should contain the following information:

Incident Report Form

Please report any incident within 24 hours to UNOPS:

Contractor	
Dam Site	
Report Date	
Reported By (Name and Title)	

i. Details of Incident

Incident Date	
Incident Time	
Incident Place	

ii. Identification of Type of Incident and Immediate Cause

1. Select the type of the incident from the list below. An incident can be classified at the same time as health&safety/environmental/social.

Type of Incident: (and incident can cover more than one type):

Type of Incident – Health & Safety		Type of Incident – Social	Type of Incident - Environmental
Moving Machinery/vehicles at project site	Dust, Fumes, Vapours that impact the population and/or environment	Misuse of Govt. property	Chemical/Oil Spill with impact on population and/or environment
Powered Hand tools	Noise	Damage to Cultural Heritage	Improper Disposal Waste
Hand Tools	Temperature or heat	Occurrence of infringement of labor rights	Disasters (Earthquake, Flood, etc)
Animals or insects	Overexertion	Occurrence of infringement of human rights	Water Pollution/ Sedimentation
Fire or Explosion at sub-project site	Structural Failure	Strike, demonstration	Damage to ecosystems (e.g. damage to flora/fauna)
Trips & smaller falls	Chemical/biological	Other (please specify)	Odor air Emissions
Drowning	Stress	GBV/SEA or Child Risks	Dust, Fumes, Vapors, Air pollution with impact on population and/or environment
Borrow-pit Management	Other (please specify)		Other (please specify)

2. For each type of incident, select the relevant descriptor(s) from the list. You can select up to 5 descriptors for each type of incident. If a descriptor is not listed below, please type in short descriptor in "Other". Add more rows as necessary.

Incident Type	Descriptor 1	Descriptor 2	Descriptor 3	Descriptor 4	Descriptor 5	Other
Health & Safety						
Social						
Environmental						

Provide a description of the immediate cause of the incident:

iii. Description of the Incident

Record all facts prior to and including the incident, if it was a planned activity, describe/list material, ecosystem and property damaged, etc:

iv. Root Cause Analysis

Select the root cause(s) of the incident from the list below. If 'Other', please specify:

Root Cause	Yes	No
Improper Planning		
Poor Maintenance		
Poor Supervision		
Poor Quality of Equipment		
No rules, standards, or procedures		
Lack of knowledge or skills		
Improper motivation or attitude		
Failure to comply with rules		
Other		

Additional Questions:
- Is the incident still ongoing or is it contained?
- Is loss of life or severe harm involved?
- What measures have been or are being implemented by the Implementer?

Appendix H: Summary of Construction Contractor Training Requirements

Training content	Number of days	Trainers/Supervision	Participants
Dam Safety-Emergency preparedness, and Community health and safety			
Emergency preparedness: Hazards, and dam failure, roles and responsibilities, emergency preparedness, emergency response procedures and grievance redress mechanism *Community health and safety: Safety talks, Pedestrian access infrastructure, Construction safety, Gender based violence, waste management, swimming risks, drowning risks, dam security, spillway crossing risks, management of livestock around the dam, use of dam water for drinking, malaria prevention and management, pollution prevention, bilharzia prevention and management and water borne diseases* *First aid: First aid basics and response*	Throughout	Construction Contractor Supervision UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist IDSP: Dam Safety Specialist Environmental Specialist	All staff Community members Contractor's first aiders

Grievance Redress Mechanism and ESMP requirements			
Sharing of the Environmental and Social Management Plan (ESMP) by Contractor to site accessing persons *Environmental management plans* *Grievance redress mechanism*	Throughout	Construction Contractor Supervision UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist IDSP: Dam Safety Specialist Environmental Specialist	All staff Community members

Appendix J: Biodiversity Assessment and Management Plan

Executive Summary

Biodiversity Assessment Results

The biodiversity assessment for the subproject area of influence revealed that the site has three main types of habitats. These are: Miombo Woodlands; Riverine or Riparian and Dambos or willow wetlands. The Miombo Woodlands on site has sporadic specialized Termitaria habitats that are formed on and around termite hills. Riparian habitats on site are dominated by *Syzygium guineense* while dambos are typically characterized by grasses, rushes and sedges. The vegetation in Miombo Woodlands is dominated by *Julbernardia globiflora*, *Combretum fragrans* and *Kirkia acuminate*.

Within the sampled area (25,136m^2 or 2.51ha), a total number of 44 terrestrial tree species were recorded. The overall number of stems across all species recorded was 898 translating into a stocking of 358 Stems/ha. In terms of specific species, *Julbernardia globiflora* had the highest number of stems with 158 representing 17.59% of the total stems, followed by *combretum fragrans* with 97 stems (10.80%); *Uapaca kirkiana* with 82 stems (9.13%) and fourth was *kirkia acuminate* with 81 stems representing 9.02%.

In terms of dominance, *Julbernardia globiflora* had the highest IV (81.69%) followed by *Combretum fragrans* (80.25%), *Kirkia acuminata* (68.57%) and *Piliostigma thonningii* with 65.82%. The four species with the least IV were: *Combretum collinum, Boscia angustifolia, Brachystegia boehmii* (all with 5.13%), and *Entada abyssinica* (5.23%). Based on the analysis results, the conclusion is that the most dominant, common or abundant flora species within the project area of influence are *Julbernardia globiflora*, *Combretum fragrans*, *Kirkia acuminata* and *Piliostigma* thonning*ii*. **No Threatened, Endangered or Critically Endangered** flora species were encountered in the project area of influence during the survey.
Regarding fauna, no large species occur in project area of influence. Twenty nine (29) mammal species were recorded with the most common being: Fruit Bats, *Epomophorus crypturus* and *Epomophorus wahlbergi*; Greater Cane Rat, *Thryonomys swinderianus*; Scrub Hare, *Lepus saxatilis*; Bush Squirrel, *Xerus inauris*; Field Mouse, *Apodemus sylvaticus*; Dwarf Mongoose, *Helogale parvula*; and African Civet, *Civettictis civetta*. All of these species are listed as Least Concern on the IUCN Red List.

A total of 22 reptile species were observed. These were mainly lizards, and snakes. The commonly observed reptiles in the area include: Flap-Necked Chameleon, *Chamaeleo dilepis*; Striped Skink, *Trachylepsis striata*; Bushveld Lizard, *Heliobolus lugubris*; Southern Rock Agama, *Agama atra*; Common File Snake, *Gonionotophis capensis*; African Rock Python, *Python sebae*; African Puff-adder, *Bitis arietans*; Twig or Vine Snake, *Thelotornis capensis*; Olive Grass Snake, *Psammophis mossambicus*; Monitor Lizard, *Varanus exanthematicus*; and Marsh Terrapin, *Pelomedusa subrufa.*

The project area of influence is rich in avifauna diversity with 84 bird species observed. This is attributed to the presence of water in the dam within the project area of influence. Of birds recorded, none is listed as Near Threatened, Threatened, Endangered, or Critically Endangered under the IUCN Red List.

During the survey, a total of seventeen (17) amphibian species were encountered or observed. These were all frogs and toads. All the recorded amphibians are listed as Least Concern under the IUCN Red List.

Based on Kleynhans (1996) tool for habitat integrity assessment, which considers changes as regards instream and riparian characteristics, modifications have occurred at Makaba Dam. The downstream area has been largely modified with respect to the aforementioned characteristics due to being starved of environmental flows.

A total of 13 phytoplanktons and 19 zooplanktons were identified in the water samples obtained at Makaba. These planktons are key components of the trophic status. A number of water quality parameters (temperature, pH, transparency, dissolved oxygen) investigated in-situ, generally registered readings within the normal ranges, though some diversions from the normal range were noted. Chemical analysis of water samples done in the laboratory at the University of Zambia, showed low levels of fertilizer constituents (ammonia, nitrates, phosphates). This could be indicative of low usage of fertilizer in the agricultural fields by the dam or alternatively high dilution capacity of the dam at the time of conducting this survey.

As regards fish species, 12 were identified namely: Blunttooth catfish (Clarias ngamensis) LC, Sharptooth catfish (Clarias gariepinus) LC, Dashtail barb (Barbus poechi) LC, Bulldog (Marcusenius macrolepidotus) LC, Nile Tilapia (Oreochromis niloticus) LC, Redbreast tilapia (Coptodon rendalli) LC, Cross (Oreochromis machrochir & Oreochromis andersonii), Butter catfish (*Schilbe intermedius*) LC, Three spotted tilapia (*Oreochromis andersonii*) VU, Greenheaded Tilapia (*Oreochromis machrochir*) VU, Banded tilapia (*Tilapia sparmanni*) LC and Thinface largemouth (*Serranochromis macrocephalus*) LC. As can be noted, all the species are of Least Concern except: *Oreochromis andersonii* (VU) and *Oreochromis machrochir (VU)*. Eleven invertebrates were encountered. These included- Dragon flies *(Anisoptera sp*.) DD, Horse fly (*Tabanus bovinus*) DD, Mosquito (*Aedes sp*) DD, Whirligig beetles *(Gyrinus natator*) DD, water boatman *(Corixidae sp*.) DD, water strider (*Gerridae sp*)DD, Mayfly (*Baetidae*) DD, Crab (*Potamonautidae sp*) DD, Snails (*Gastropoda sp*)DD Leeches DD, Worms DD.

Aquatic plants encountered were six. Namely included bullrush (*Typha angustifolia),* Filamentous algea (*Pleurastrum terricola)* cattail *(Typha latifolia)*, Giant reeds (*Phragmites sp*.), and smartweed *(Polygonum pensylvanicum*)

Predicted Project Impacts

The project impacts on flora and fauna during the construction works for the remediation of the dam will be mainly due to clearing for access roads, worker's camp, parking and working areas for equipment. These and associated activities may result in the following potential impacts:

- Loss of indigenous vegetation on site;
- Loss of fauna habitats and consequently loss of fauna;
- Habitat fragmentation;
- Injury or mortality of fauna resulting from collision with vehicles, equipment on site; increased noise levels and likely hunting activities;
- Introduction of invasive species and pathogens as a result of movement of people and equipment into and out of the project area of influence; and
- Possible loss of aquatic fauna and flora as a result of water contamination.

These impacts constitute relatively minor risks that can be managed by well-known and proven construction impact methodologies. Overall, the rehabilitation of unremediated areas from the previous construction is expected to stabilize the environment around the dam wall and other areas of project

disturbance, resulting in a reduction in erosion and sedimentation into the dam and the local drainage line. Provision is made for the management of these risks in the ESMP and in this BMP.

Subject to the recommended mitigation, the continued operation of the dam is not expected to have material negative biodiversity impacts in the long term. Terrestrial and aquatic habitats in the area of influence of the dam have been significantly impacted over many years by subsistence cultivation, clearing of woodlands for firewood and charcoal and grazing for cattle. Habitat integrity in the area of influence of the dam is generally low due to decades of human activities. This is unlikely to change because of the remedial works on the dam. Since the stream is seasonal and at the upper end of the catchment, there are no migratory fish movements of significance. The dam does not pose a barrier effect to the fish population. The two fish species listed on the IUCN Red List that were found during the study occur primarily because of the permanent water provided by the dam. The major threat to these two species, the Nile tilapia, introduced into the Kafue River system, appears to be present near and in the dam's impoundment. Further introduction of the invasive species is not promoted as a management measure in the BMP.

While the habitat integrity of the stream downstream of the dam is lower than the upstream reach, this does not appear to be related to habitat transformation caused by sediment settling in the dam and there is no significant increase in downstream erosion caused by the stream that could be attributed to erosive waters. The main reason for poor habitat integrity downstream appears to be the practice of cultivation in the seasonally wet parts of the dambos and general habitat degradation in the surrounding areas due to bush clearing and overgrazing. Key management requirements are to continue efforts to improve catchment conditions to protect the water resource. Smart weed control in the reservoir area has to be controlled in order to sustain the dam and not attributed to the presence of the dam's impoundment.

Proposed Mitigation Measures

Proposed mitigation measures are detailed in this BMP. For the construction phase, key measures are:

- Use of old site access roads, camp site, borrow pits and working areas to avoid clearing of new areas;
- All vegetation clearing activities will be subject to approval by the Project and Environmental Manager on site;
- Clearing the smartweed that is slowing forming a blanket-like thicket on the water surface within the reservoir
- Nonuse of indigenous timber/wood for construction works on site. Required timber or wood will be procured from licensed pine and/or eucalyptus dealers;
- Planting or seeding of alien or foreign flora species will not be allowed;
- Poaching (hunting) or killing of wildlife on site will not be permitted by the workers and will constitute breach of contract;
- Enforcement of speed limits;
- Vehicle and machinery operation will be restricted to daylight hours to avoid collisions with priority nocturnal and crepuscular fauna;
- No construction and related project activities will be permitted within dambos on site;
- Bush burning and or open fires in forested or vegetated areas will not be permitted;
- Training and capacity building: key employees and community members will be sensitized/trained in natural resources management, implementation of the BMP and their roles as well the importance of conservation;

For the operational phase, key measures are to provide training and support to the local communities to manage livelihood activities in the catchment, encouraging protection and sustainable use of the aquatic resource provided by the dam. These are to include:

- Sensitizing the local community to sustainable fishing methods, invasive species and the importance of conserving aquatic resources;
- Training the dam committee to maintain the dam wall by removing woody vegetation, encouraging grass growth, removing aquatic weeds and controlling access by stock to minimize erosion paths;
- Supporting the local community to determine and implement sustainable farming practices in the dam catchment, by prohibiting cultivation in the riverine areas and around the perimeter of the dam, limiting habitat degradation due to clearing of woodlands and maintaining stocking ratios that do not result in significant overgrazing.

This support will initially be provided by the UNOPs project team and in the long term by the Ministry of Agriculture, Forestry and Fisheries and DMC.

Objectives of the BDA

Overall Objective

The overall objective of this BMP is to guide the remedial works on Makaba Dam. The implementation of the BMP will mitigate imminent identified risks to the aquatic environment, terrestrial environment, and their associated livelihoods, and bring the dam's operational management into compliance with WB safeguards policies. Particular emphasis is put on the presence of sensitive habitats and species with a conservation status of concern (both flora and fauna).

Specific Objectives for Terrestrial Assessment

Specific Objectives of the Flora Assessment

i. To identify the botanical attributes of the project, including:
    - Compilation of species lists of all observed flora species;
    - Description of the extent and type of native species present;
    - Verification of the presence of threatened species or vegetation communities (per the IUCN Red List) ;
ii. To quantify the botanical attributes of the assessment site (if necessary), to:
    - Identify the species and size class found within the site, and determine the ecological/habitat significance of each; and
    - Map the locations of threatened flora species and indicate potential habitat for threatened species.
iii. To quantify the regeneration and invasive species status of the area.

Specific Objectives of the Fauna Assessments

i. To identify the fauna present in the area including:
    - Compilation of species lists of all observed fauna species;

- Documentation of the presence of threatened species or animal communities (per the IUCN Red List);

ii. To quantify the faunal attributes of the assessment site (if necessary), to:

- Determine species diversity within and around the project, and determine the ecological/habitat significance of each;
- Map the locations of threatened animal species and indicate potential habitat for threatened species;
- Identify existing and potential invasive species and cross breeding status at the sites.

Specific Objectives for Aquatic Assessment

- Collect, collate and compile comprehensive baseline information on the aquatic and riverine/riparian ecosystems;
- Determine the significance of aquatic ecological impacts caused by the dams, taking direct, indirect and cumulative impacts into consideration;
- Identify and describe the potential structural and non-structural measures to at least maintain or increase the ecological flow downstream of the dams;
- Develop Biodiversity Management Plans for the affected dams under the project.

METHODOLOGY

This section of the report outlines the methods adopted for the assessment of existing ecological habitats, flora and fauna on site.

Assessment Methodology

Spatial scale-procedures to determine project's area of influence

Terrestrial

This dam is considered as category B project, the direct area of influence for the terrestrial assessment is commensurate with other category B projects. The preliminary scoping also indicated that there was no need to have a larger direct area of influence.The dam's area of influence was determined using its estimated throwback. For this purpose, throwback used was 1.7Km estimated from Google Earth Map. Taking the dam's throwback as a radius of a circle whose center is the middle point of the dam wall, a circle was drawn to determine the spatial extent of the dam's influence. Using this method, the determined area of influence for Makaba Dam is shown in Figure 3-1. Sampling was done within the determined area of influence.

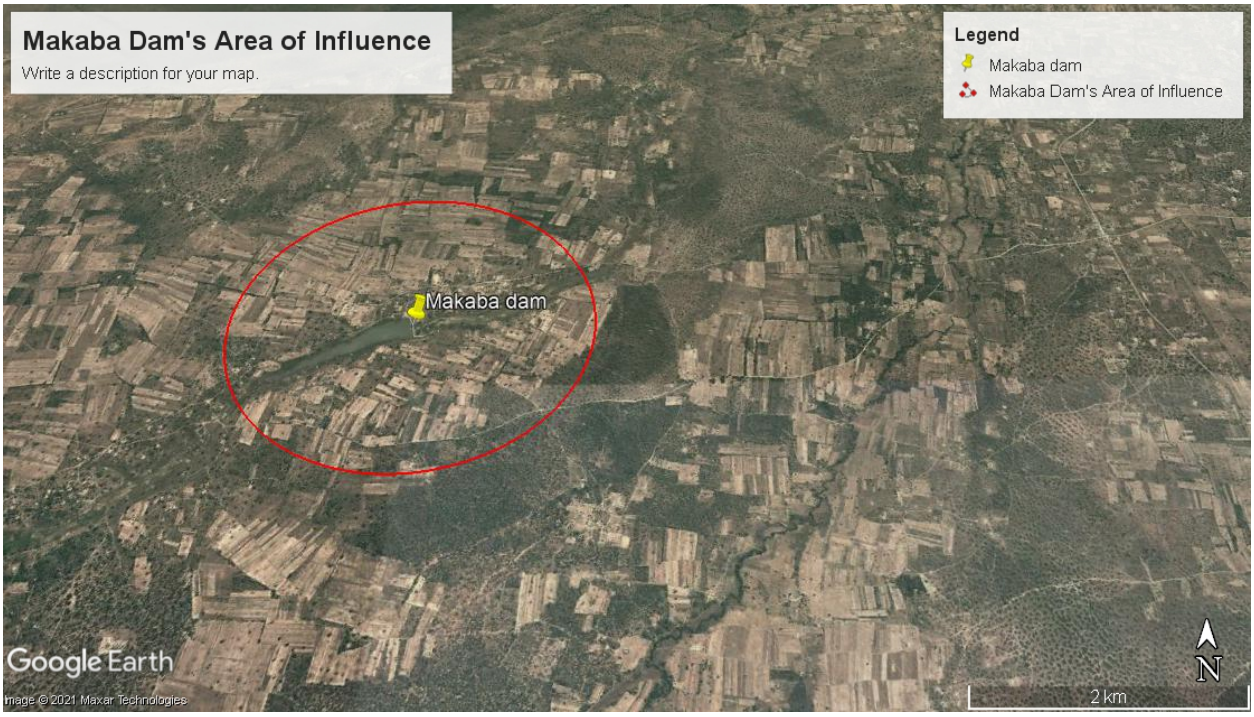


Figure 0-1: Makaba Dam area of influence

Aquatic

This dam is considered as category B project, the direct area of influence for the aquatic assessment is commensurate with other category B projects. The preliminary scoping also indicated that there was no need to have a larger direct area of influence. Projects' area of influence for aquatic biodiversity assessments was determined by the extent of the water in the reservoir plus a 1km stretch upstream and downstream. A 1km distance down-stream was especially necessary to assess the impact in an event that the dam wall failed. This stretch was also considered adequate to understand the down-stream impact of the impoundment. Further, a 10-20m radius from the edges of either side of the dam and also the river was covered to understand riparian vegetation/flora.

Value of ecological resources and vulnerability of receptors

Terrestrial

In order to determine the value or integrity of terrestrial habitats, the criteria shown in Table 3-1 were adopted. Vulnerability of receptors was determined by employing the IUCN conservation status/value.

Table 0-1: Criteria for habitat integrity (William Latimer, 2009)

Criteria for defining habitat quality
High quality: • High degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hallow-bearing trees, and a dense understory component. • High species richness and diversity (i.e. represented by a large number of species from a range of flora and fauna groups). • High contribution to a wildlife corridor, and/or connected to a larger area of high quality habitat.

• Habitat that has experienced or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity). • Provides known, or likely habitat for one or more rare or threatened species listed under the IUCN.
Moderate quality: • Moderate degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hallow-bearing trees, and a dense understory component. • Moderate species richness and diversity (i.e. represented by a large number of species from a range of fauna groups). • Moderate levels of foraging and breeding activity, with the site used by native fauna for refuge and cover. • Moderate contribution to a wildlife corridor, and/or connected to a larger area of high quality habitat. • Habitat that has experienced or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity). • Unlikely to provide known, or likely habitat for one or more rare or threatened species listed under the IUCN.
Low quality: • Low degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hallow-bearing trees, and a dense understory component. • Low species richness and diversity (i.e. represented by a large number of species from a range of fauna groups). • Low levels of foraging and breeding activity, with the site used by native fauna for refuge and cover. • Unlikely to form part of a wildlife corridor, and/or connected to a larger area of high quality habitat. • Habitat that has experienced or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity). • Unlikely to provide known, or likely habitat for one or more rare or threatened species listed under the IUCN.

Determination of the quality or value of vegetation was done using the criteria presented in Table 3-2.

Table 0-2: Criteria for vegetation integrity

Criteria for defining vegetation condition
High quality: Vegetation dominated by a diverse indigenous species, with defined structures (where appropriate), such as canopy layer, shrub layer, and ground cover, with little or few introduced species present.
Moderate quality: Vegetation dominated by a diversity of indigenous species, but is lacking some structures, such as canopy layer or ground cover.
Low quality: Vegetation dominated by introduced species, but supports low levels of indigenous species present, in the canopy, shrub layer or ground cover.

Aquatic

This section explains the criteria used in quantifying aquatic ecological resources in the project area of influence of influence. To evaluate instream and riparian ecosystems, the methodology developed by Kleynhans (1996) was employed. Vulnerability of receptors was determined by employing the IUCN conservation status/value. Table 3-3 shows the criteria used for aquatic habitat integrity assessment.

Table 0-3: Criteria for aquatic habitat integrity (Kleynhans, 1996)

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon et al., 1993). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993) is also included
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly, or alternatively indicated by human settlements, agricultural and industrial activities. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon et al., 1992).
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river (Gordon *et al*., 1992). Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochthonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.

Descriptive classes for the assessment of modifications to habitat integrity were adopted from Kleynhans, 1996. These are shown in Table 3-4.

Table 0-4: Descriptive classes for the assessment of modifications to habitat integrity (Kleynhans, 1996).

Impact Category	Description	Score
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modification is present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

Table 3-5 shows criteria and weights used for the assessment of habitat integrity (Kleynhans, 1996).

Table 0-5: Criteria and weights used for the assessment of habitat integrity (Kleynhans, 1996).

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Flow modification	13	Exotic vegetation encroachment	12
Water quality	14	Exotic vegetation encroachment	12
Water abstraction	14	Inundation	11
Inundation	10	Water abstraction	13
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	7		
TOTAL	**100**	**TOTAL**	**100**

***NB**: Scores are then calculated based on ratings received from the assessment. The estimated impacts of the criteria are then summed and expressed as a percentage to arrive at a provisional habitat integrity assessment. The scores are then placed into the intermediate habitat integrity assessment categories (Kleynhans, 1996) as seen in Table 3-6.*

Table 0-6: Intermediate habitat integrity assessment categories (Kleynhans, 1996)

Category	Description	Score

A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80 - 90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60 - 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 - 59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 - 39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 - 19

Evaluation of significance of Impacts

In the criteria for the evaluation of impacts adopted for this study, the following factors were considered in classifying each potential impact generated by the sub-project:

- **Frequency:** Occurrence of activity producing the impact, e.g. continuous, intermittent or a single event/less than once per year;
- **Likelihood:** Probability of impact occurrence (e.g., 100%, 50%, 0%);
- **Extent:** Spatial extent of the impact (e.g. within 2km of site boundary, outside the Project but within 20km, within 200km, within Zambia, outside Zambia.
- **Duration:** Extent in time of the impact. Short term impact (less than the life of the project), medium term impacts (equal to the lifetime of the Project) and long term impacts (greater than the lifetime of the Project);
- **Magnitude:** Impact magnitude defined in relation to the limit criterion specified by ZEMA or international standards where available.
- **Type of impact:** Positive or negative effect; direct or indirect action.
- **Potential significance:** A combination of all the factors described in the preceding bullet points is used to determine the type and significance of potential impact prior to mitigation. This is defined as low, medium or high.

Table 3-7 presents the terminology used to describe and rank environmental and social impacts according to the categories defined above.

Table 0-7: Terminology used to describe environmental and social impacts

Category	Terminology	Definition
Scope of Impact[(1)]		
Frequency	Frequent Infrequent Rare	Uninterrupted or on a daily basis Once or more per day Less than once per day Single event/less than once per year
Likelihood	Certain Likely	Impact possibility estimated to be 100% Impact possibility estimated as between 50% and 99%

Category	Terminology	Definition
	Unlikely No impact	Impact possibility estimated as < 50% Zero estimated possibility of impact
Extent	Local Provincial Regional National International	Within 2 km of the Project Outside the Project area of influence but <20 km away Outside the Project area of influence but < 200 km away Within Zambia Outside Zambia
Duration	Short Medium Long	Less than the life of Project The life of project Greater than the life of Project
Magnitude[(2)]	Very low Low Medium High Very high	Defined in relation to the limit criterion where available, e.g.: • Very low: Parameter < 10% limit criterion • Low: Parameter 10 to <50% limit criterion • Medium: Parameter 50 – 100% limit criterion • High: Parameter 100 – 200% limit criterion • Very High: Parameter > 200% limit criterion. Or, for qualitative assessments: • Very low: No degradation/adverse alteration to resource/receptor • Low: Minor degradation/adverse alteration to resource/receptor • Medium: Moderate degradation/adverse alteration to resource/receptor. • High: Significant degradation/adverse alteration to resource/receptor. • Very High: Permanent degradation/detrimental alteration to resource/receptor.
Type of Impact		
Effect	Positive Negative	Beneficial impact Adverse impact
Action	Direct Indirect	Impact caused solely by activities within scope of Project Impact which does not result directly from by activities within the scope of Project, but which has a connection with the Project's presence.
Potential Significance		
Significance	Low Medium High	Any low magnitude impact, or medium magnitude impact that is unlikely to occur or is of short duration. Any medium magnitude impact that is certain or likely to occur and of medium or long duration. Also, any high magnitude impact that is unlikely to occur, of short duration, or local in extent. Any high magnitude impact that is certain or likely to occur, of medium or long duration, and regional in extent.
(1)	All terms are characteristics of the impact(s). For example, duration refers to duration of impact, not the activity causing it.	
(2)	As indicated, the impact magnitude for some environmental aspects can be defined in relation to the limit criterion specified by ZEMA or international regulations, or best practices when	

Category	Terminology	Definition
	national standards are not available. However, in the absence of definitive quantitative criteria, a qualitative assessment of the magnitude is used relating to the impact type.	

Approach to mitigation of impacts

The conservation objectives and management actions in the BMP have been developed to ensure that the mitigation hierarchy is consistent with the WB's approach i.e. anticipate and avoid risks and impacts; where avoidance is not possible, minimize or reduce risks and impacts to acceptable levels; once risks and impacts have been minimized, mitigate; and, when significant residual impacts remain, compensate for, or offset them when technically and financially feasible.

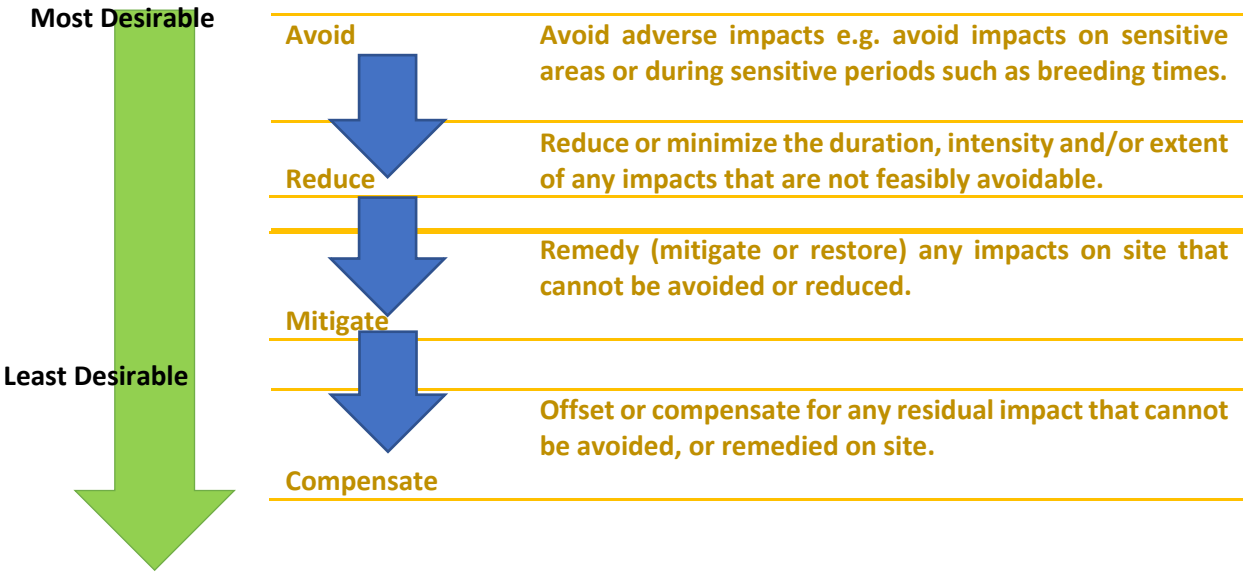


Figure 0-2: Impact Mitigation hierarchy adopted

Data Collection Methods

Desk review

Desk study or review was done prior to undertaking site surveys. The purpose of the review was to help develop the study methodology and prepare for the field work. It was used to collect secondary data relevant for the terrestrial and aquatic ecological assessment.

Documents reviewed included but not limited to:

- Environmental and Social Audit Report and Remedial Action Plan for Ten Dams in Zambia under the IDSP;
- Initial Environmental Project Brief for Makaba Dam
- Various ecological studies including Zambia Environmental Management Agency Approved ESIAs and EPBs carried out in Southern Province with focus on those close to the project
- Satellite images of the project

The review also included internet research with the following websites being the main ones consulted:

- IUCN Red List;
- Birdlife Data Zone; and
- Ramsar Website

Completion of field surveys

Terrestrial field surveys

Terrestrial field surveys were done over a period of three days (14th to 16th April, 2021). The surveys were aimed at providing a broad understanding of the terrestrial ecology values of the study area, including vegetation composition, the presence or potential presence of conservation significant flora and fauna, and habitat suitability for fauna.

Flora surveys

To come up with representative samples, a mixture of sampling methods was used for the field flora survey within the project's area of influence. These methods were Stratified Random Sampling, Purposive Sampling and Point Counts.

Stratified Random Sampling was used because it was observed during desktop review via satellite images and the reconnaissance survey that the project was highly fragmented. First, the project area of influence is split by the dam into the up and downstream as well as the East and West banks or sides. Additionally, Agricultural activities (maize, groundnuts, sunflower fields and vegetable gardens) and settlements within the project area of influence have further fragmented the site. Additionally, it was observed that the site had a number of diverse vegetation types or habitats such as Miombo woodlands, riparian and dambos. In order to assess vegetation in all the areas (upstream and downstream as well as sides of the dam), across all vegetation types (habitats), and in the available fragmentations, strata were made following these groups. Sampling within these strata was randomly done.

Purposive Sampling and Point Count was used in instances were species of interest are observed singularly or in a group at a point not marked for sampling. These were recorded and coordinates keyed in.

In total, 20 sampling plots were established. These plots were circular and had a radius of 20m translating into an approximate area of 1,256m^2 per plot. Therefore the total area sampled was 25,120m^2. For the sampling plots, the radius of 20m was chosen because studies have shown that circular plots with 12 to 20m radius capture adequate data in the inventory of the Zambezian phytoregion (Geldenhuys, 2004; Densanker, Frost, Justice, & Scholes, 1997; Zimba, 1991). Another advantage is that the circular plots are easier to establish in the field compared to square plots.

The coordinates for the locations of the sample plots is given in Appendix 1.

Table 3-8 shows the parameters that were taken from the main plots. All the measurements taken on the tree parameters from the main plot were recorded on the main plot data collection form (Appendix 2).

Table 0-8: Parameters measured from the main plot

Parameter	Comment
Diameter at Breast Height (DBH)	Taken on each tree in cm
Bole height	Taken in m
Total Height	Measured in m
Tree condition	Crooked, moribund, etc…
Tree species	Identified by use of check lists and KYT
Crown size	In m
Evidence of fire	
Health of canopy	In %

Vegetation type	Marquesia, Parinari forest etc.

The data collection team comprised of 6 individuals divided into 2 groups. Each group had an Ecologist, Assistant Ecologist and a local person. The 20m radius plots were subdivided into semi-circle plots with each team handling one half of the plot. To ensure consistency in the data collection, a protocol was followed (Table 3-9).

Table 0-9: Flora data collection protocols

Flora Data Collection Protocols	
1	*Measuring tree diameter* • For trees with diameters greater than 5cm, measure diameter of the tree at 1.3 m from the ground • Record diameter to the nearest 0.5 cm • A leaning tree should always be recorded on the lower or underneath side • If the tree forks or there is some deformity at 1.3m, get diameter below the fork and above the deformity respectively and indicate the "forked" or "deformed" in the remarks column of the main form. • If the tree breaks into two or more stems at or near ground level record measure diameter at 1.3m of the biggest tree
2	*Measuring tree height* • Height is read to the nearest 1 meter • Ensure that the horizontal distance to the centre of the tree from the observer is accurately taken • Ensure reading the correct scale • Ensure that the effect of lean on any measurement is corrected by taking readings from diametrically opposite points and average calculated or measurement to be taken at right angles to the plane of the lean. • Ensure that the device or instrument is in good working condition before use. • Always stand on the same level of ground as the tree, i.e. do not measure from up or down a slope but across the slope • If your vision is obstructed to the tip or top most branches of the tree either take a different baseline or estimate where the top is and record the height as estimated • If possible, always check the height using more than one baseline taken in different directions from the tree • If a tree is dead in its upper crown or dying back, the height recorded should be to the highest live branch, although the height it had reached will be of interest if not recorded before • For leaning trees get height from both sides (leeward and leaning)
3	*Regeneration* • Count all the tree species with diameter <5cm and height <50cm • Identify the tree species
4	*Health of canopy cover* • Measure the health of the canopy in percentage • Observe the canopy cover using the visual guide provided

In each main plot, six (3m x 3m) regeneration sub-plots were established. On these plots all seedlings below 5cm diameter and 50cm height were recorded. Regeneration measurement involved counting and

identifying the species in the 3m x 3m plots. Regeneration data were recorded on the regeneration data collection form (see Appendix 3). Weeds were also identified.

Fauna assessment

The number of fauna study or assessment sites was determined by the number of habitats on site. Assessments were done in all habitats (vegetation types) observed on site. Habitats present in the area were identified during desk review via satellite images and confirmed during reconnaissance survey. Using these methods, identified habitats on site were: Riverine Vegetation (Riparian); Miombo woodlands with specialized habitats such as Anthills (Termitaria) and Dambos. These are presented in Figure 3-3.

Litter in the sampling plots was turned over in search of terrestrial macroinvertebrates, amphibians and reptiles. All species encountered were identified based on morphological features using field guides. Encountered fauna species were recorded on Fauna Data Sheet shown in Appendix 4.

The fauna survey involved direct observation (during daylight hours) of signs of activity which included prints, tracks, hairs, droppings, odour, digging and evidence of feeding.

To survey small mammals, standard Sherman traps were used (Figure 3-4). These traps were laid in strategic areas that were established following the nature of the habitats and sightings as testified by the locals. The traps were exposed for over 12 hours from 17:00 hours to 07:00 hours the following day. The trapped specimens were identified based on their morphological features using field guides. The Sherman Traps were baited with small balls of peanut butter mixed with maize meal and in some cases just Jungle Oats.

For birds, observations were made from 06:00 – 08:00 hours in the morning and 15:00 - 17:00 hours in the afternoon. Birds were identified based on their morphological features described by Sinclair et al. (2002) and Sinclair and Ryan (2010). They were further assessed through droppings; vocal availability; footprints; roost, flock and nesting structures. The data collected were recorded in the data recording form (Appendix 4).

Other survey techniques employed to assess the baseline fauna (including birds, mammals, reptile, amphibians and invertebrates) present in the project area of influence include:

- Point count and play back calls
- Field walks
- Direct search and observations
- Indirect method (noticing the presence of foot prints, tracks, droppings, burrows or digging and evidence of feeding)

a). Miombo woodlands

b). Dambo (willow wetland)

c). Riparian or riverine vegetation

Figure 0-3: Habitat types observed within project area of influence

Figure 0-4: Small mammal trapping using (a) Standard Sherman trap

To enhance the chances of observing various fauna in the project area of influence, camera traps were set in all observed habitat. The camera traps were left in the filed for two days and nights. Figure 3-5 shows the cameras set in the field. The cameras were set at knee height so that even small fauna can be captured.

Figure 0-5: Field camera trap for fauna observation

Invertebrates: Observations for invertebrates were made directly while in the field. Litter in the sampling plots was turned over in search of terrestrial macroinvertebrates. Further, to enhance the chances of

observing insects that are active on the ground, pit fall traps were set in the field. Two types of pit fall traps were used. These were cup sized traps (500ml) and bucket sized traps (10 litres).

Interviews: Community members, mainly members of the Makaba Dam Management Committee (DMC) were interviewed for the purpose of collecting data on the type of animals; location, distribution and frequency of occurrence. Community members were also asked if any of the plants that were initially available in the area are now non-existent. Figure 3-6 shows a focus group discussion held with members of the DMC regarding wildlife in the area.

Figure 0-6: Group interview with members of the Makaba DMC on terrestrial and aquatic wildlife in the area

The following key interview questions were used to collect data on wildlife resources in the area:

- What types of animals (mammals, birds, reptiles, amphibians and insects) were once present in the area?
- What animals are found in the area today? and
- What has caused the changes in animal population structures?
- For bird species, checklist of questions included:
- What type of migratory birds you usually see in the area?
- Do you notice any strange or extraordinary birds during certain seasons?
- Do you know their names?
- When do they appear and leave each season?

Aquatic field surveys

Data were collected at Makaba on 3 consecutive days. That is on the 14th, 15th and 16th of April, 2021. On the first day, aside from collecting data on water quality, plankton, fish, invertebrates, aquatic flora and habitats, a reconnaissance survey was conducted.

Reconnaissance Survey: The team of two (lead ecologist and a technician) undertook a reconnaissance survey of Makaba Dam on 14th April, 2021 in the company of some community members. This exercise was cardinal as regards having an in-depth knowledge of the area. Further, it guided sampling protocols.

Selection of sampling points: Stratified and purposive sampling was employed in a bid to generate data required for the study. The reservoir and the stream were stratified into five strata namely; upstream, the point where the stream enters the reservoir, midpoint of the reservoir, dam wall and downstream. This sampling design enhances chances of obtaining representative data on fauna, flora, water quality, planktons and habitats for the area under review. The coordinates for sampling points are indicated in

table 3-10. Data captured at each one of the sampling points were recorded on the attached data sheets (Appendix 6)

Table 0-10: Coordinates for the points sampled

Coordinates		Location Description
		Downstream
S16.07823 degrees	E026.92135 degrees	At the weir
S16.07907 degrees	E026.92134 degrees	Mid-section of reservoir
		Point of entry of stream into reservoir
S16.10950 degrees	E026.84182 degrees	Upstream

Water Quality: A calibrated multi-water parameter checker was employed to measure water quality. In situ parameters considered in this study included temperature, pH, dissolved oxygen, conductivity and transparency. The sampling points were accessed by a boat.

Planktons: Water samples were collected in the field from sampling points using a plankton net. In total, two water samples were collected at each sampling point. The collected water samples were fixed with 90% ethanol. The water samples were taken to the laboratory for analysis of plankton; and chemical parameters which were not addressed in-situ.

Fish: A variety of sampling gears were applied to sample fish species. The fishing gear used depended on the characteristics of the sampling station. The fishing gear included gill nets, long lining and seine net. On average, fishing for samples was conducted for 2 hours during day time at a particular station. This being the case, it's possible to compute Catch per unit of effort (CpUE), which is an index of biomass.
Each individual fish captured at any sampling station was weighed and its length taken. Captured fish were identified to species level by using field guides developed by Skelton (2001), and Utsugi & Mazingaliwa (2002).

Macroinvertebrates Survey: Invertebrates on the surface of water were captured using a scoop net and identified using a guide developed by Sims & Blaylook (2002). For those invertebrates occupying the streambed, the streambed was deliberately disturbed by use of a stick in a bid to dislodge them. As the plume of the silt rose, the scoop net was employed to capture any dislodged invertebrates; which were identified using a magnifying glass and a field guide (Sims & Blaylook, 2002).

Aquatic Flora: At each particular sampling station and within its vicinity, all aquatic plants were identified using a field guide developed by Carruthers (2016).

Habitat integrity: Since the area under review had 3 distinctly different components, namely upstream, reservoir and downstream, observational walks were undertaken along the length and breadth of each component to study the general attributes. Further, in the case of the reservoir, offshore observational excursions were taken by use of an inflatable boat.

Criteria for aquatic habitat integrity developed by Kleynhans (1996) were employed to ascertain the habitat integrity of each component (upstream, reservoir, downstream). This involved assessment of the instream and riparian components.
Interviews with community members: The DMC members were interviewed (Fig.3-6). The interview was guided by following questions:

- What aquatic fauna/flora is found in the dam and the stream?
- What gear is employed in harvesting fish by fishers?
- What are the notable challenges with respect to securing the dam and its constituents?

Data Analysis

Terrestrial Data Analysis

Microsoft Excel was used to analyze the data on flora. The species data was used to determine species importance values (IV) and species richness. IVs were calculated as adopted from DWAF (2005). Species IV are useful in determining the performance of the species in a given area.

For plants with dbh ≥ 5 cm

$$\text{Importance value (IV)} = \frac{RF + RD + RBA}{3}$$

Where:

- RF = Relative Frequency;
- RD = Relative Density; and
- RBA = Relative Basal Area.
-

IV measures the relative dominance of species in a forest community (Curtis & Mcintosh, 1959). IV rank species within a site based upon three criteria:

1. How commonly a species occurs across the entire forest area
2. The total number of individuals of the species and
3. The total amount of forest occupied by the species

Before calculating the IVs, Relative Frequency (RF), Relative Density (RD), Relative Basal Area (RBA), and Abundance of each tree species encountered was calculated. To calculate RF, RD and RBA, the following formulae were used:

$$\text{Relative frequency} = \frac{\text{Number of plots in which species is present} * 100}{\text{Total number of plots recorded}}$$

$$\text{Relative density} = \frac{\text{Number of stems recorded for species} * 100}{\text{Number of stems recorded for all species}}$$

$$\text{Abundance} = \frac{\text{Total Number of stems recorded for species}}{\text{Total number of quadrants in which the species occurred}}$$

$$\text{Relative basal area} = \frac{\text{Basal area of a species in a community} * 100}{\text{Total basal area of all species in the community}}$$

Regarding fauna, field guides were used to identify the encountered species based on morphological features. Paw prints were compared against those in field guide books for fauna identification. Animal droppings observed were identified based on shape and constituents. In this case, field guide book was also used.

Aquatic data analysis

During this survey, data were collected on fish, invertebrates, flora, water quality, plankton and habitats. This section provides a breakdown of how the data was analyzed.

Microsoft excel (2008) was used to analyze fish data. Further, Catch per Unit Effort (CpUE) for a particular gear was computed using the formula:

Catch per Unit Effort (CpUE) = Total catch of fish (Kg)/Fishing Effort (Time in hrs).

Additionally, the IUCN red list of threatened species was employed to guide on the conservation status of fish. With respect to flora and invertebrates, here too the IUCN red list of threatened species was employed to ascertain their conservation status.

Reference values for pH, dissolved oxygen, conductivity and water transparency were used to explain the water quality values obtained in-situ.

In order to ascertain whether the direct area of influence is modified/converted or natural, a habitat integrity analysis was conducted using a tool designed by Kleynhans (1996).

Water samples containing planktons, were taken to the Department of Fisheries in Chilanga for identification. Analysis of chemical parameters of water samples not measured in-situ was conducted at The University of Zambia.

RESULTS AND DISCUSSION

Terrestrial Survey Results

Habitats

Three types of habitats were identified with Makaba Dam's area of influence. These were: Miombo Woodlands; Riverine or Riparian and Dambos or willow wetlands (Fig. 3-3). Miombo Woodlands on site host sporadic specialized Termitaria habitats that are formed on and around termite hills.

Riparian habitats on site are dominated by *Syzygium guineense* while dambos are typically characterized by grasses, rushes and sedges.

The vegetation in Miombo Woodlands is dominated by *Julbernardia globiflora*, *Combretum fragrans* and *Kirkia acuminate*. Special habitats or Areas of interest within the Miombo woodlands on site are:

- *Ficus brachylepis* and *Parinari curatellifolia* colony at S16.10486^0 and E026.84497^0: This area hosts fruit bats, *Epomophorus crypturus* and *Epomophorus wahlbergi.* The *Ficus brachylepis* trees provide shelter while *Parinari curatellifolia* provides fruits (food) for the bats; and
- Musuku, *Uapaca Kirkiana* Forests *at* S 16.09949^0, E 026.85435^0 and S 16.10493^0, E 026.84506^0: These two forests provide Musuku fruits for both people and fauna within the project area of influence

For management and/or conservation purposes, important Dambos in the Makaba Dam catchment and area of influence have been surveyed, their coordinates recorded and presented in Appendix 5.

In terms of value or importance, the three main habitats are classified in Table 14, with reasons for the classification given.

Table 0-11: Evaluation of the importance or value of habitats on site

Type of Habitat		Classification Value (importance)	Reasons for Classification
1.	Miombo Woodlands		
	a. General Miombo Woodland	Low	Quality or value of Miombo Woodlands' habitats on site has been greatly compromised and fragmented by: ○ Agriculture: patches of vegetation on site have been cleared to commit the areas to agricultural activities (Fig. 4-1 c); ○ Cutting down of trees for charcoal production (Fig. 4-1 d), fencing of cattle kraals and gardens, and kilning of bricks; ○ Settlements within the project area of influence (Fig. 4-1 b); and ○ Some portions of the site have been invaded by the exotic *Euphobia* plant (Fig. 4-1 e),;

Type of Habitat		Classification Value (importance)	Reasons for Classification
			Owing to the above reasons, vegetation cover in the project is poor with most trees having diameters less than 10cm and there are no well-defined vegetation or forest structures.
	b. Termitaria	Low	The quality or integrity of these specialized types of Miombo habitats on site have been reduced because of the exploitation of its soils (termite hill soils) for brick making. This is very true especially in the areas close to the settlements.
2.	Riparian or Riverine	Medium	• In areas far from settlements, it was observed that riverine vegetation is far less disturbed, almost intact (Fig. 3-3 c), • In areas close to settlements, riverine vegetation has been, in most cases cleared to pave way for gardening activities (Fig. 4-1 a),
3.	Dambos	Low	• Exploitation of Dambos for cattle and goats grazing has resulted in the reduction of the value or quality of these habitats on site. This has led to reduced abilities of the Dambos to perform their natural ecosystem services for water retention.

The overall low quality or value of habitats on site is clearly attributed to anthropogenic activities like settlements; agriculture; garden fencing and making of kraals; cattle and goats grazing; and Termite Hill Soil Brick making.

a). Gardening on dam/river banks within riparian habitats

b). Settlements in project area of influence

c). Agriculture activities within miombo woodlands on site

d). Charcoal production on site

e). Invasive *Euphobia* plants on site

Figure 0-7: Land uses contributing to habitats' degradation in the project area of influence

Flora

For the purpose of the flora survey within Makaba Dam's area of influence, a total number of 20 circular plots with a radius of 20m each were established. This represents a total sampled area of 25,136m^2 or 2.51ha.

Within the sampled area, a total number of 44 tree species were recorded. The overall stem across all species recorded was 898 translating into a stocking of 358 Stems/ha. The average tree DBH recorded was 10.04cm. The relatively small average DBH is attributed to past massive tree cutting for agriculture, charcoal production, garden and kraal fencing as well as Earth Brick kilning.

In terms of specific species, *Julbernardia globiflora* had the highest number of stems with 158 representing 17.59% of the total stems. It is followed by *combretum fragrans* with 97 stems (10.80%); *Uapaca kirkiana* with 82 stems (9.13%) and fourth was *kirkia acuminate* with 81 stems representing 9.02%.

The Relative Frequency, Relative Density, Abundance, Relative Basal Area, and the Importance Value of all species recorded are presented in Table 4-2.

Important values (IV) measure the relative dominance of species in a forest community (Curtis, 1959). IV rank species within a site based upon three criteria:

a) How commonly a species occurs across the entire forest area,
b) The total number of individuals of the species and
c) The total amount of forest occupied by the species

From Table 4-2 *Julbernardia globiflora* had the highest IV (81.69%) followed by *Combretum fragrans* (80.25%), *Kirkia acuminata* (68.57%) and *Piliostigma thonningii* with 65.82%. The four species with the least IV were: *Combretum collinum, Boscia angustifolia, Brachystegia boehmii* (all with 5.13%), and *Entada abyssinica* (5.23%).

Based on the analysis results, the conclusion is that the most dominant, common or abundant flora species within the project area of influence are *Julbernardia globiflora*, *Combretum fragrans*, *Kirkia acuminata* and *Piliostigma* thonning*ii*.

No Threatened, Endangered or Critically Endangered flora species were encountered in the project area of influence during the survey.

Table 0-12: Relative frequency, relative density, relative basal area and iv

Species Name	No. of stems	Relative Frequency	Relative Density	Abundance	Total basal area	Importance Value index	IUCN Status
Acacia polyacantha	6	5	0.63	6.00	0.004713	5.66	LC
albizia harveyi	27	45	2.85	3.00	0.02205684	47.88	LC
albizia versicolor	14	15	1.48	4.67	0.0263928	16.55	LC
Berchemia discolor	11	20	1.16	2.75	0.0103686	21.19	LC
Borassus aethiopum	31	45	3.27	3.44	0.02264597	48.29	LC
Boscia angustifolia	1	5	0.11	1.00	0.00057342	5.13	LC
Brachystegia boehmii	1	5	0.11	1.00	0.00064411	5.13	LC
Burkea africana	6	5	0.63	6.00	0.00348762	5.65	LC
Cassia abbreviata	4	10	0.42	2.00	0.00317342	10.45	LC
Colophospermum mopane	4	10	0.42	2.00	0.00229366	10.44	LC
Combretum collinum	1	5	0.11	1.00	0.00054985	5.13	LC
Combretum fragrans	97	70	10.22	6.93	0.0761935	80.25	LC
Combretum zeyheri	13	25	1.37	2.60	0.0095988	26.40	LC
Dalbergia retusa	2	5	0.21	2.00	0.0010997	5.23	LC
Dalbergia melanoxylon	6	5	0.63	6.00	0.0056556	5.67	LC
Dalbergia nitidula	5	10	0.53	2.50	0.00726588	10.58	LC
Diospros kirkii	7	10	0.74	3.50	0.01044715	10.79	LC
Diplorhynchus condylocarpon	23	30	2.42	3.83	0.03486835	32.48	LC
Dombeya erythroleuca	3	5	0.32	3.00	0.00195590	5.34	LC
Ekebergia benguelensis	4	10	0.42	2.00	0.00543566	10.47	LC
Entada abyssinica	2	5	0.21	2.00	0.00111541	5.23	LC
Entandrophragma caudatum	6	10	0.63	3.00	0.00346406	10.65	LC
Ficus brachylepis	15	5	1.58	15.00	0.02422482	6.64	LC
Ficus capensis	18	15	1.90	6.00	0.02378180	16.95	LC
Ficus sycomorus	13	15	1.37	4.33	0.01093652	16.40	LC
Guibourtia coleosperma	4	5	0.42	4.00	0.00213028	5.44	LC
Julbernardia globiflora	158	65	16.65	12.15	0.178841069	81.69	LC

Species Name	No. of stems	Relative Frequency	Relative Density	Abundance	Total basal area	Importance Value index	IUCN Status
Kirkia acuminata	81	60	8.54	6.75	0.08150427	68.57	LC
Ozoroa reticulata	4	5	0.42	4.00	0.00264871	5.45	LC
Parinari curatellifolia	18	25	1.90	3.60	0.01996427	26.94	LC
Pericopsis angolensis	30	40	3.16	3.75	0.03372152	43.20	LC
Piliostigma thonningii	55	60	5.80	4.58	0.03214266	65.82	LC
Pterocarpus angolensis	4	10	0.42	2.00	0.00224653	10.44	LC
Pterocarpus luceus	25	35	2.63	3.57	0.0177523	37.66	LC
Salix subserrata	12	15	1.26	4.00	0.01888028	16.32	LC
Strychnos cocculoids	7	15	0.74	2.33	0.00507512	15.76	LC
Strychnos potatorum	20	40	2.11	2.50	0.01643266	42.14	LC
Syzygium guineense	6	5	0.63	6.00	0.00382696	5.66	LC
Terminalia brachystemma	7	15	0.74	2.33	0.00406339	15.76	LC
Terminalia sericea	39	40	4.11	4.88	0.02717280	44.14	LC
Terminalia stuhlmannii	4	10	0.42	2.00	0.00231880	10.44	LC
Thespesia garckeana	12	25	1.26	2.40	0.01317755	26.31	LC
Uapaca kirkiana	82	45	8.64	9.11	0.10453905	53.69	LC
Vitex doniana	10	15	1.05	3.33	0.00725017	16.08	LC
Total	**898**						

Frequency refers to the degree of dispersion in terms of percentage occurrence (Shukla and Chandel 2000). The species that is not well distributed will occur in few quadrants and as such their frequency will be low. Higher frequency implies that the species is widely spread in the area. The abundance of the species was determined and assigned to abundance classes such as Rare (1≤F≤4); Occasional (5≤F≤14); Frequent (15≤F≤29); Abundant (30≤F≤90) and Very Abundant (100+) per square meter quadrant (Table 4-3).

Table 0-13: Abundance classes for sampled tree species

No.	Species Name	Relative Frequency	Abundance Class
1	*Combretum fragrans*	70	Abundant
2	*Julbernardia globiflora*	65	Abundant
3	*Kirkia acuminata*	60	Abundant
4	*Piliostigma thonningii*	60	Abundant
5	*Albizia harveyi*	45	Abundant
6	*Borassus aethiopum*	45	Abundant
7	*Uapaca kirkiana*	45	Abundant
8	*Pericopsis angolensis*	40	Abundant
9	*Strychnos potatorum*	40	Abundant
10	*Terminalia sericea*	40	Abundant
11	*Pterocarpus luceus*	35	Abundant
12	*Diplorhynchus condylocarpon*	30	Abundant
13	*Combretum zeyheri*	25	Frequent
14	*Parinari curatellifolia*	25	Frequent
15	*Thespesia garckeana*	25	Frequent
16	*Berchemia discolor*	20	Frequent
17	*Albizia versicolor*	15	Frequent
18	*Ficus capensis*	15	Frequent
19	*Ficus sycomorus*	15	Frequent
20	*Salix subserrata*	15	Frequent
21	*Strychnos cocculoids*	15	Frequent
22	*Terminalia brachystemma*	15	Frequent
23	*Vitex doniana*	15	Frequent
24	*Cassia abbreviata*	10	Occasional
25	*Colophospermum mopane*	10	Occasional
26	*Dalbergia nitidula*	10	Occasional
27	*Diospros kirkii*	10	Occasional
28	*Ekebergia benguelensis*	10	Occasional
29	*Entandrophragma caudatum*	10	Occasional
30	*Pterocarpus angolensis*	10	Occasional
31	*Terminalia stuhlmannii*	10	Occasional

No.	Species Name	Relative Frequency	Abundance Class
32	*Acacia polyacantha*	5	Occasional
33	*Boscia angustifolia*	5	Occasional
34	*Brachystegia boehmii*	5	Occasional
35	*Burkea africana*	5	Occasional
36	*Combretum collinum*	5	Occasional
37	*Dalbergia retusa*	5	Occasional
38	*Dalbergia melanoxylon*	5	Occasional
39	*Dombeya erythroleuca*	5	Occasional
40	*Entada abyssinica*	5	Occasional
41	*Ficus brachylepis*	5	Occasional
42	*Guibourtia coleosperma*	5	Occasional
43	*Ozoroa reticulata*	5	Occasional
44	*Syzygium guineense*	5	Occasional

Concerning frequency or how well a species is spread across the study, none of the recorded flora was classified as Very Abundant. This could be because of the habitat destruction caused by anthropogenic activities in the area. However, 12 of the recorded species were classified as Abundant. These were: *Combretum fragrans; Julbernardia globiflora; Kirkia acuminate; Piliostigma thonningii; albizia harveyi; Borassus aethiopum; Uapaca kirkiana; Pericopsis angolensis; Strychnos potatorum; Terminalia sericea; Pterocarpus luceus;* and *Diplorhynchus condylocarpon*. Of these, *Combretum fragrans* was the most widespread with a Relative Frequency of 70%. Eleven (11) species were found to be Frequent while Twenty One (21) were Occasional. It is worth noting that none of the recorded species had an Abundance Class of Rare. This means that no species in the area is locally threatened or endangered.

Regarding stocking or number of stems per given area, the extrapolated value for the whole sampled area was 358 Stems/ha. This indicates a low stocking or degraded Miombo because high value Miombo Woodlands usually have the stocking of at least 500 Stems/ha. In terms of specific species stocking, *Julbernardia globiflora* was the highest with 63 Stems/ha followed by *Combretum fragrans* (39 Stems/ha), and *Uapaca kirkiana* and *Baphia bequaertii* (both had 33 Stems/ha). Extrapolated number of Stems per hectare for all observed tree species is shown in Table 4-4.

Table 0-14: Stocking or stems per hectare within the Project area of influence

Species Name	No. of stems	Stocking (Stems/ha)
Julbernardia globiflora	158	63
Combretum fragrans	97	39
Uapaca kirkiana	82	33
Kirkia acuminata	81	33
Piliostigma thonningii	55	22
Terminalia sericea	39	16
Borassus aethiopum	31	13

Species Name	No. of stems	Stocking (Stems/ha)
Pericopsis angolensis	30	12
albizia harveyi	27	11
Pterocarpus luceus	25	10
Diplorhynchus condylocarpon	23	10
Strychnos potatorum	20	8
Ficus capensis	18	8
Parinari curatellifolia	18	8
Ficus brachylepis	15	6
albizia versicolor	14	6
Combretum zeyheri	13	6
Ficus sycomorus	13	6
Salix subserrata	12	5
Thespesia garckeana	12	5
Berchemia discolor	11	5
Vitex doniana	10	5
Diospros kirkii	7	3
Strychnos cocculoids	7	3
Terminalia brachystemma	7	3
Acacia polyacantha	6	3
Burkea africana	6	3
Dalbergia melanoxylon	6	3
Entandrophragma caudatum	6	3
Syzygium guineense	6	3
Dalbergia nitidula	5	2
Cassia abbreviata	4	2
Colophospermum mopane	4	2
Ekebergia benguelensis	4	2
Guibourtia coleosperma	4	2
Ozoroa reticulata	4	2
Pterocarpus angolensis	4	2
Terminalia stuhlmannii	4	2
Dombeya erythroleuca	3	2
Dalbergia retusa	2	1
Entada abyssinica	2	1
Boscia angustifolia	1	1
Brachystegia boehmii	1	1
Combretum collinum	1	1
Total	**898**	**358**

Regeneration: A total number of 45 species were noted under regeneration with a combined number of stems of 4,429. These numbers show that the project area of influence is vigorously regenerating and with proper management can recover from the anthropogenic activities that have degraded its vegetation. In terms of regeneration stocking density, the sampled area has 1,765 Stems/ha showing a very health rejuvenation rate.

In terms of specific species, *Julbernardia Globiflora* had the highest number of wildlings' stems recorded with 277 stems representing 6.25% of the total followed by *Brachystegia boehmii* with 205 stems (4.63%) and *Uapaca Kirkiana* with 190 stems (4.29%). Ozoroa reticulata had the least number of wildlings recorded with 34 (0.77%) while Ficus capensis was second lowest with 42 wildling stems representing 0.95% of the total. Overall, all the wildlings recorded were abundant in terms of Frequency, relative density and Importance Value. Table 4-5 shows the number of stems and percentage of the total for all wildlings in the sampled area.

None of the recorded flora species under regeneration has been listed as Threatened, Near Threatened, Endangered or Critically Endangered.

Table 0-15: Regeneration in sampled area

	REGENERATION	No of Stems	% of the Total	IUCN Status
1	*Julbernardia globiflora*	277	6.25	LC
2	*Brachystegia boehmii*	205	4.63	LC
3	*Uapaca kirkiana*	190	4.29	LC
4	*Albizia harveyi*	167	3.77	LC
5	*Acacia sieberana*	144	3.25	LC
6	*Diplorhynchus condylocarpon*	123	2.78	LC
7	*Acacia polyacantha*	122	2.75	LC
8	*Combretum zeyheri*	115	2.60	LC
9	*Piliostigma thonningii*	111	2.51	LC
10	*Albizia versicolor*	109	2.46	LC
11	*Pterocarpus luceus*	109	2.46	LC
12	*Vitex doniana*	104	2.35	LC
13	*Kirkia acuminata*	103	2.33	LC
14	*Cassia abbreviata*	102	2.30	LC
15	*Diospros kirkii*	102	2.30	LC
16	*Pericopsis angolensis*	102	2.30	LC
17	*Combretum fragrans*	99	2.24	LC
18	*Dalbergia melanoxylon*	98	2.21	LC
19	*Euibourtia coleosperma*	98	2.21	LC
20	*Parinari curatellifolia*	97	2.19	LC
21	*Terminalia sericea*	93	2.10	LC
22	*Berchemia discolor*	91	2.05	LC
23	*Strychnos cocculoids*	91	2.05	LC
24	*Strychnos potatorum*	90	2.03	LC

	REGENERATION	No of Stems	% of the Total	IUCN Status
25	*Ekebergia benguelensis*	89	2.01	LC
26	*Entandrophragma caudatum*	89	2.01	LC
27	*Pterocarpus angolensis*	89	2.01	LC
28	*Terminalia brachystemma*	89	2.01	LC
29	*Terminalia stuhlmannii*	87	1.96	LC
30	*Combretum collinum*	84	1.90	LC
31	*Balanites aegyptiaca*	78	1.76	LC
32	*Dombeya erythroleuca*	78	1.76	LC
33	*Salix subserrata*	78	1.76	LC
34	*Dalbergia nitidula*	76	1.72	LC
35	*Borassus aethiopum*	71	1.60	LC
36	*Ficus sycomorus*	69	1.56	LC
37	*Entada abyssinica*	67	1.51	LC
38	*Ficus brachylepis*	67	1.51	LC
39	*Syzygium guineense*	67	1.51	LC
40	*Acacia erioloba*	66	1.49	LC
41	*Boscia angustifolia*	57	1.29	LC
42	*Combretum Celastroides*	56	1.26	LC
43	*Thespesia garckeana*	54	1.22	LC
44	*Ficus capensis*	42	0.95	LC
45	*Ozoroa reticulata*	34	0.77	LC
Totals		**4429**	**100.00**	

Fauna

Mammals in the project area of influence

The fauna field survey recorded a total of 29 mammal species in Makaba Dam's area of influence. Eight (8) of these species were physically encountered in the field. These were: Fruit Bats, *Epomophorus crypturus* and *Epomophorus wahlbergi*; Greater Cane Rat, *Thryonomys swinderianus*; Scrub Hare, *Lepus saxatilis*; Bush Squirrel, *Xerus inauris*; Field Mouse, *Apodemus sylvaticus*; Dwarf Mongoose, *Helogale parvula*; and African Civet, *Civettictis civetta*.

Observed signs of occurrence for mammals in the project area of influence are shown in Figure 4-2. The full list of Mammals recorded in the project area of influence is presented in Table 4-6.

Table 0-16: List of mammals recorded in the area

No.	Scientific Name	Common Name	IUCN Status
1	*Epomophorus crypturus*	Fruit bat	LC
2	*Epomophorus wahlbergi*	Fruit bat	LC
3	*Thryonomys swinderianus*	Greater cane rat	LC
4	*Mus minutoides*	African pygmy mouse,	LC
5	*Ichneumia albicauda*	White-tailed mongoose	LC
6	*Rhabdomys pumilio*	African striped mouse	LC
7	*Dendromus melanotis*	African climbing mouse	LC
8	*Apodemus sylvaticus*	Field mouse	LC
9	*Lepus saxatilis*	Scrub hare	LC
10	*Xerus inauris*	Bush squirrel	LC
11	*Paraxerus cepapi*	Tree squirrel	LC
12	*Cercopithecus aethiops*	Vervet monkey	LC
13	*Helogale parvula*	Dwarf mongoose	LC
14	*Genetta genetta*	Common genet	LC
15	*Felis lybica*	African wild cat	LC
16	*Cryptomys hottentotus*	Common mole-rat	LC
17	*Otolemur crassicaudatus*	Thick-tailed Bush-baby	LC
18	*Sylvicapra grimmia*	Common duiker	LC
19	*Phacochoerus aethiopicus*	Warthog	LC
20	*Mellivora capensis*	Honey badger	LC
21	*Vulpes chama*	Fox	LC
22	*Hystrix cristata*	Porcupine	LC
23	*Rattus rattus*	Black rat	LC
24	*Cryptomys mechowi*	Giant mole rat	LC
25	*Cryptomys hottentotus*	Common mole Rat	LC
26	*Philantomba monticola*	Blue duiker	LC
27	*Canis adustus*	Side-striped Jackal	LC
28	*Papio ursinus*	Chacma baboon	LC
29	*Civettictis civetta*	African civet	LC

None of the mammals observed in the project area of influence is listed as Near Threatened, Threatened, Endangered, or Critically Endangered under the IUCN Red List. Endangered and Threatened species listed

in the Environmental and Social Audit Report and Remedial Action Plan for Ten Dams in Zambia may have been picked by the IBAT from the nearby Kafue Flats.

African pygmy mouse, *Mus minutoides* burrow

Field mouse, *Apodemus sylvaticus* burrow

Common Mole rat, Cryptomys hottentotus' burrowing signs

African Hare, *Lepus victoriae* droppings

Left over fruits eaten by Fruit bats, *Epomophorus crypturus*

Figure 0-8: Signs of mammals' occurrence in the project area of influence

Reptiles

The study recorded a total number of 22 reptile species. These were mainly snakes and lizards. The low number of reptile observed is attributed to the fact that reptile camouflage themselves and are very difficult to observe on site over a short period of time. Table 4-7 shows all reptiles recorded during the survey.

Table 0-17: Reptiles present in Makaba area

No.	Scientific Name	Common Name	IUCN Status
1	*Varanus exanthematicus*	Monitor lizard	LC
2	*Acanthocerus atricollis*	Southern Tree Agama	LC
3	*Acanthocercus branchi*	Agama	LC
4	*Indotyphlops braminus*	Common Blind Snake	LC
5	*Dispholidus typus*	Boomslang	LC
6	*Chamaeleo lavigatus*	Chameleon	LC
7	*Heliobolus lugubris*	Bushveld Lizard	LC
8	*Trachylepsis striata*	Striped Skink	LC
9	*Trachylepis boulengeri,*	Boulenger's mabuya	LC
10	*Ichnotropis bivittata*	Angolan rough-scaled lizard	LC
11	*Chamaeleo dilepis*	Flap-Necked Chameleon	LC
12	*Agama atra*	Southern Rock Agama	LC
13	*Naja melanoleuca*	Forest Cobra	LC
14	*Stigmochelys pardalis*	Leopard Tortoise	LC
15	*Denroaspis angusticeps*	Green Mamba	LC
16	*Gonionotophis capensis*	Common File Snake	LC
17	*Naja nigricollis nigricincta*	Black–necked Spitting Cobra	LC
18	*Python sebae*	African Rock Python	LC
19	*Bitis arietans*	African Puff-adder	LC
20	*Dendroaspis polylepis*	Black Mamba	LC
21	*Thelotornis capensis*	Twig or Vine Snake	LC
22	*Psammophis mossambicus*	Olive Grass Snake	LC

Birds

Regarding birds, the survey recorded a total of 84 species. This indicates a high bird species diversity especially that the area studied had a diameter of just over 2.8Km. A number of wetland/dambo species were observed owing to the presence of these habitats on site and the nearby Kafue flats were they thrive. Figure 4-3 shows some of these birds observed on site while Table 4-8 is a list of all birds recorded.

Marabou stork, *Leptoptilos crumeniferus*

Juvenile Grey heron, *Ardea alba*

Black Heron, *Egretta ardesiaca*

Cattle egrets, *Bubulcus ibis*

Figure 0-9: Some bird species observed within the project area of influence

Table 0-18: List of all bird species observed within the project area of influence of influence

No	Scientific name	Common name	IUCN Status
1	*Leptoptilos crumeniferus*	Marabou stork	LC
2	*Ardea cinerea*	Grey heron	LC
3	*Egretta ardesiaca*	Black heron	LC
4	*Laniarius aethiopicus*	Tropical boubou	LC
5	*Dryoscopus cubla*	Black-backed Puffback Shrike	LC
6	*Cinnyricinclus leucogaster*	Violet-Backed (Plum-coloured) Starling	LC
7	*Spermestes cucullata*	Bronze mannikin	LC
8	*Numida meleagris*	Guinea fowl	LC
9	*Spilopelia senegalensis*	Laughing dove	LC
10	*Streptopelia decipiens*	African mourning dove, mourning collared dove	LC
11	*Streptopelia semitorquata*	Red-eyed Dove	LC
12	*Turtur chalcospilos*	Emerald-spotted Wood Dove	LC
13	*Gallinula chloropus*	Common moorhen	LC
14	*Amaurornis flavirostra*	Black crake	LC
15	*Milvus aegyptius*	Yellow-billed kite	LC
16	*Pytilia afra*	Orange-winged (golden-backed) pytilia	LC
17	*Lagonosticta nitidula*	Brown firefinch	LC

No	Scientific name	Common name	IUCN Status
18	*Lagonosticta rubricata*	African (Blue-billed) Firefinch	LC
19	*Scopus umbretta*	Hamerkop	LC
20	*Phoeniculus purpureus*	Green wood-hoopoe	LC
21	*Ploceus capensis*	Cape weaver	LC
22	*Ploceus subaureus*	Golden weaver	LC
23	*Cinnyris manoensis*	Miombo double-collared sunbird	LC
24	*Chalcomitra amethystina*	Amethyst (black) sunbird	LC
25	*Chalcomitra senegalensis*	Scarlet-chested sunbird	LC
26	*Anthreptes longuemarei*	Western violet-backed sunbird	LC
27	*Ploceus bicolor*	Forest weaver	LC
28	*Muscicapa striata*	Spotted flycatcher	LC
29	*Motacilla aguimp*	African pied wagtail	LC
30	*Lybius torquatus*	Black-collard Barbet	LC
31	*Pogoniulus chrysoconus*	Yellow-fronted Tinkerbird	LC
32	*Dendropicos namaquus*	Bearded woodpecker	LC
33	*Mirafra rufocinnamomea*	Flappet lark	LC
34	*Hirundo rustica*	European swallow	LC
34	*Oriolus larvatus*	Black-headed Oriole	LC
36	*Corvus albus*	Pied crow	LC
37	*Turdoides jardineii*	Arrow-marked Babbler	LC
38	*Phyllastrephus terrestris*	Terrestrial brownbul	LC
39	*Sylvia borin*	Garden warbler	LC
40	*Cisticola juncidis*	Zitting (Fan-tailed) Cisticola	LC
41	*Terpsiphone viridis*	African paradise-flycatcher	LC
42	*Lanius collaris*	Common fiscal shrike	LC
43	*Zosterops senegalensis*	African yellow white-eye	LC
44	*Cinnyris venustus*	Variable (yellow-bellied) sunbird	LC
45	*Cinnyris talatala*	White-bellied sunbird	LC
46	*Cinnyris cupreus*	Copper (coppery) sunbird	LC
47	*Ploceus cucullatus*	Village (spotted-backed) weaver	LC
48	*Anaplectes melanotis*	Red-headed weaver	LC
49	*Ploceus velatus*	Masked weaver	LC
50	*Centropus senegalensis*	Senegal coucal	LC
51	*Quelea quelea*	Red-billed Quelea	LC
52	*Euplectes orix*	Southern Red-bishop	LC
53	*Euplectes afer*	Yellow-Crowned (Golden) bishop	LC
54	*Euplectes capensis*	Yellow Bishop (Cape/Yellow-Rumped widow)	LC
55	*Uraeginthus angolensis*	Blue waxbill	LC
56	*Estrilda astrild*	Common waxbill	LC
57	*Vidua macroura*	Pin-tailed Whydah	LC
58	*Urocolius indicus*	Red-faced Mousebird	LC
59	*Colius striatus*	Speckled mousebird	LC
60	*Halcyon senegalensis*	Woodland kingfisher	LC
61	*Halcyon albiventris*	Brown-headed Kingfisher	LC
62	*Halcyon chelicuti*	Striped kingfisher	LC

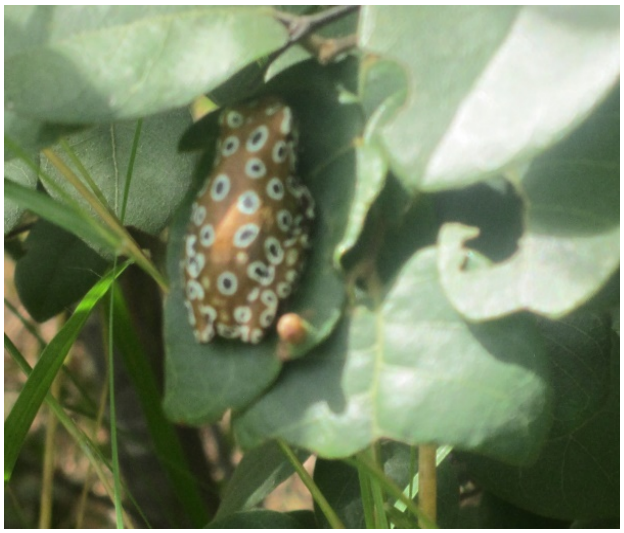
No	Scientific name	Common name	IUCN Status
63	*Pycnonotus tricolor*	Dark-capped (black- eyed) bulbul	LC
64	*Streptopelia capicola*	Cape turtle (ring-necked) dove	LC
65	*Oena capensis*	Namaqua dove	LC
66	*Treron calvus*	African green pigeon	LC
67	*Bubulcus ibis*	Cattle egret	LC
68	*Poicephalus suahelicus*	Grey-headed parrot	LC
69	*Poicephalus meyeri*	Meyer's (brown) parrot	LC
70	*Macrodipteryx vexillarius*	Pennant-winged nightjar	LC
71	*Merops pusillus*	Little bee-eater	LC
72	*Coracias caudatus*	Lilac-breasted roller	LC
73	*Halcyon leucocephala*	Grey-headed kingfisher	LC
74	*Dicrurus adsimilis*	Fork-tailed drongo	LC
75	*Muscicapa adusta*	African dusky flycatcher	LC
76	*Hirundo rustica*	Barn (european) swallow	LC
77	*Sylvietta rufescens*	Long-billed crombec	LC
78	*Camaroptera brevicaudata*	Grey-backed camaroptera	LC
79	*Tauraco schalowi*	Schalow's turaco	LC
80	*Prinia subflava*	Tawny-flanked prinia	LC
81	*Cercropis cucullata*	Greater striped swallow	LC
82	*Emberiza cabanisi*	Cabanis's bunting	LC
83	*Dendropicos griseocephalus*	Olive woodpecker	LC
84	*Dendropicos fuscescens*	Cardinal woodpecker	LC

Amphibians

The amphibian survey of the Makaba Dam's area of influence recorded a total number of 17 species. All these species were frogs and toads. The high number of frogs and toads in the project area of influence is attributed to the availability of water on site. This is because water is critical for survival and reproduction of these amphibians.

Some of the amphibians observed on site are shown in Figure 4-4 while a full list of the amphibians recorded during the study is presented in Table 4-9.

None of the recorded amphibian species is listed as Threatened, Endangered, or Critically Endangered as per IUNC Red List status.



Laurent's reed frog, *Hyperolius rhodesianus*

Dartevelle's reed frog, *Hyperolius dartevellei*

Figure 0-10: Some Amphibians observed on site during field surveys

Table 0-19: List of amphibians recorded onsite

No.	Scientific Name	Common Name	IUCN Status
1	*Hyperolius rhodesianus*	Laurent's reed frog	LC
2	*Hyperolius dartevellei*	Dartevelle's reed frog	LC
3	*Pyxicephalus edulis*	Lesser or Edible Bull frog	LC
4	*Phrynobatrachus parvulus*	Dwarf puddle frog	LC
5	*Amietia angolensis*	Angola or Common River Frog	LC
6	*Amietophrynus lemairii*	Yellow swamp toad	LC
7	*Hyla versicolor*	Gray Tree frog	LC
8	*Lithobates sylvaticus or Rana sylvatica*	Wood frog	LC
9	*Hyperolius marmoratus white*	Painted reed frog	LC
10	*Hyperolius pictus*	Variable reed frog	LC
11	*Chiromantis xerampelina*	Grey foam-nest tree frog	LC
12	*Ptychadena anchietae*	Plain grass frog	LC
13	*Sclerophrys pusilla*	Toad	LC
14	*Pyxicephalus adspersus*	Giant bull frog	LC
15	*Strongylopus bonaspei*	Striped stream frog	LC
16	*Sclerophrys pusilla*	Eastern flat-backed toad	LC
17	*Schismaderma carens*	African road toad	LC

Invertebrates

Thirty One (31) invertebrate species were recorded during the survey. Most of these were grasshoppers, locusts, crickets, ants and butterflies. Some of the observed invertebrates are shown in Figure 4-5 while the full list is presented in Table 4-10.

None of the observed invertebrates within the project area of influence is listed as Threatened, Endangered, or Critically Endangered under the IUCN Red List. Further, no invertebrates endemic to the area were observed i.e. all observed invertebrates are wide spread within the country and region.

Locust, *Ornithacris pictula*

Long-horned beetle, family: Cerambycidae

Giant Coreid bug, *Anoplocnemis curvipes*

Figure 0-11: Some invertebrates observed on site

Table 0-20: Invertebrates observed on site

No.	Scientific Name	Common Name	IUCN Status
1	Ornithacris pictula	Locust	LC
2	*Anoplocnemis curvipes*	Giant coreid bug,	LC
3	Family: *Cerambycidae*	Long-horned beetle	LC
4	*Trichonephilia clavipes*	Spider	LC
5	*Acraea eponina*	Butterfly	LC
6	*Madateuchus viettei*	Dung beetle	DD
7	*Julus terrestris*	Millipedes	DD
8	*Danaus chrysippus*	African monarch	LC
9	*Leptotes pirithous*	Common blue	LC
10	*Belenois aurota*	Brown-veined white	LC
11	*Colotis danae*	Scarlet tip	LC
12	*Nephila senegalensis*	Banded legged golden orb-web spider	LC
13	*Family: Ageleni*	Nursery web spider	LC
14	*Pyrota lineata*	Blister beetle	DD

No.	Scientific Name	Common Name	IUCN Status
15	*Apis mellifera*	Honey bees	DD
16	*Microtermes goliath*	Termites	DD
17	*Trithemis kirbyi*	Dragon fly	LC
18	*Julida julida*	Diplopod	DD
19	*Caelifera*	Grasshopper	DD
20	*Eurema brigitta,*	Butterflies	LC
21	*Carabidea*	Beetles	DD
22	*Dorylus helveolus*	Ants	DD
23	*Belonogastar junceus*	Wasps	DD
24	*Musca domestica*	House fly	DD
25	*Brachytrypas membraneus*	Giant crickets	DD
26	*Halyomorpha halys*	Stink bug	DD
27	*Chinavia hilaris*	Green stink bug	DD
28	*Acanthoplus discoidalis*	Giant cricket	LC
29	*Nezara viridula*	Southern green stinkbug	LC
30	*Enyaliopsus parduspes*	Common koringkriek/armoured cricket	LC
31	Conocephalus conocephalus	African meadow katydid	LC

Aquatic Survey Results

Habitats
Damming of the river has resulted in creation of 3 sub-habitats (Table 4-11).

Table 0-21: Aquatic habitats

Habitat Type	Sub-Habitats	Characteristics
River	Upstream	Water flows at a slow pace. The banks lined with vegetation. Instream, there is emergent vegetation; and fauna. In the dry season, water remains in ponds/ dambos (Appendix 5) which form aquatic habitats. These dambos are up to about 2.5m deep.
	Reservoir	Open waters or pelagic with very little flow, owing to the dam wall. Edges lined with vegetation. Instream, there is emergent vegetation; and fauna. A section of the weir, damaged allowing escape some water from the reservoir towards downstream.
	Downstream	Fragmented. Pools of water/ dambos in places; a slow flowing stream. The stream is seasonal therefore flows are not notable after the rainy season. Depressions in the riverbed collect water and support life forms. These dambos are up to about 2.5m deep.

Moderate modifications have occurred within some components of the reservoir and upstream too (table 4-12 through to table, 4-17). In the downstream environment, large modifications have taken place (table 4-16 & table 4-17). This is due to absence/inadequate environmental flows downstream. The downstream environments are usually highly dependent on the sediment dynamic that can be perturbated due to

change in the water flow, for instance, presence of a weir. The whole system (upstream, reservoir, downstream), has been moderately modified, considering that it has an average ranking of 64 (table 3-6). Though, the downstream portion is considered to have been largely modified.

Table 0-12: The riparian assessment - upstream

Riparian	Average score	Score
Indigenous vegetation removal	18	8.64
Exotic vegetation encroachment	0	0
Bank erosion	8	1.68
Channel modification	8	3.84
Water abstraction	3	1.56
Inundation	3	1.32
Flow modification	8	3.84
Water quality	3	1.56
Total Riparian	**72.56**	
Category C		**(Moderately modified)**

Table 0-13: The instream assessment - upstream

Instream	Average score	Score
Water abstraction	8	7.28
Flow modification	13	6.76
Bed modification	13	6.76
Channel modification	8	4.16
Water quality	3	1.68
Inundation	8	3.2
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total instream	**70.16**	
Category C		**(Moderately modified)**

Table 0-14: The instream assessment - reservoir

Instream	Average score	Score
Water abstraction	8	4.48
Flow modification	18	9.36
Bed modification	8	4.16
Channel modification	18	9.36
Water quality	3	1.68
Inundation	18	7.2
Exotic macrophytes	0	0
Exotic fauna	3	0.96
Solid waste disposal	0	0
Total instream	**62.76**	
Category C		**(Moderately modified)**

Table 0-15: The riparian assessment - reservoir

Riparian	Average score	Score
Indigenous vegetation removal	18	8.68
Exotic vegetation encroachment	0	0
Bank erosion	8	4.48
Channel modification	3	1.56
Water abstraction	3	1.56
Inundation	3	1.32
Flow modification	8	3.84
Water quality	3	1.56
Total Riparian	**77**	
Category C		**(Moderately modified)**

Table 0-16: The instream assessment - downstream

Instream	Average score	Score
Water abstraction	8	4.48
Flow modification	23	11.96
Bed modification	20	10.4
Channel modification	25	13
Inundation	20	8
Exotic macrophytes	0	0
Exotic fauna	3	0.96
Solid waste disposal	0	0
Total instream	**51.2**	
Category D		**(Largely modified)**

Table 0-17: The riparian assessment for - downstream

Riparian	Average score	Score
Indigenous vegetation removal	18	8.64
Exotic vegetation encroachment	0	0
Bank erosion	20	11.2
Channel modification	10	5.5
Water abstraction	10	5.2
Inundation	20	8.8
Flow modification	20	9.6
Total Riparian	**51.06**	
Category D		**(Largely modified)**

Water Quality

The status of water quality is key as regards sustainability within an ecosystem. Good water quality is indicative of a suitable environment for various life forms. During this study, in- situ measurements pertaining to water quality included pH, dissolved oxygen, water transparency (turbidity) and temperature. Values of these parameters obtained in-situ are shown (Table 4-18). Laboratory results for

pH and conductivity are included in Table 29 in brackets. Other laboratory results are shown in Appendix 7. A comparison of the monitoring values with reference values (Table 4-18), indicates the following:

- Dissolved oxygen at all sampling stations registered values within normal range except at the weir where the value obtained is slightly higher.
- pH values obtained across all stations fall within normal range, except at the point where stream enters reservoir. It falls outside the lower limit of the normal range. It inclines towards acidity.
- Temperature values obtained at all stations, except at the weir and downstream, fall outside the prescribed normal range.
- Conductivity values were far less than the recommended ones at all the sampling stations except downstream. Conductivity is a measure of dissolved ions which are crucial for the ecosystem functioning. A low value of conductivity is indicative of less dissolved ions and the converse is true. Conductivity is useful as a general measure of water quality. Each water body tends to have a certain range of conductivity that, once established, can be used as a baseline for comparison with regular conductivity measurements. Significant changes in conductivity are often an indicator that a discharge or some other source of pollution has entered the aquatic resource.
- Transparency was within normal range at all the stations. This allows for easy penetration of light, a critical component for primary production (Tanebe et al, 2019).

Table 0-22: Water quality. Reference values adopted from Svobodova, Z and Machov, J. (1993). Water quality and fish health. FAO Manual.

Sampling point	DO (mg/L)	Temp (°C)	pH	Conductivity (µS/cm)	Transparency/T (cm)
Reference values	**5-7.5**	**25-30 degree C**	**6.5-8.5**	**150-500**	**25-60**
Downstream	6.92	25	6.86 (6.39)	195 (212)	36
At the weir	8.61	26.6	7.19 (6.78)	65.2 (48)	42
Midpoint of the dam	7.81	24.1	7.73 (6.64)	63.3 (75)	37
Point where river enters dam	5.9	24.3	5.80 (6.39)	67.7 (79)	44.5
Upstream	6.54	21.6	6.53 (6.52)	60 (214)	32

Results arising from analyzing water samples show very small quantities of ammonia, nitrates and phosphates (appendix 7). Suffice to mention that these are major constituents of fertilizers used in Zambia. Since there are some agricultural activities within the vicinity of the dam, this could mean that there is low usage of fertilizers or could be attributed to the high dilution capacity of the dam as at the time of conducting this study. These chemicals if present in huge quantities in a water body, are capable of precipitating an algae bloom which could impact negatively on the whole ecosystem.

In the water samples analyzed by the Department of Fisheries, 13 phytoplanktons and 19 zooplanktons (appendix 7) were identified. The former, form the base of food chain in aquatic system as they act as energy transducers and convert the solar energy into chemical energy of food. The latter, transport this food energy to the higher trophic levels and thus provides a link between energy producers and the consumers. Generally, planktons are important biological indicators of water quality and trophic status of aquatic ecosystem as they respond quickly to the environmental changes.

Fish Survey

Table 0-23: Fish species captured and their attributes

Family	Species	Total weight in (g) captured	Relative abundance (%)	IUCN status	Migratory species (Yes/No)
Clariidae	*Blunttooth catfish (Clarias ngamensis)*	**1790**	**44.31**	**LC**	No
	Sharptooth catfish (Clarias gariepinus)	**940**	**23.27**	**LC**	No
Cyprinidae	*Dashtail barb (Barbus poechi)*	**55**	**1.36**	**LC**	No
Mormyridae	*Bulldog (Marcusenius macrolepidotus)*	**450**	**11.14**	**LC**	No
Cichlidae	*Nile perch Oreochromis niloticus*	**565**	**13.98**	**LC**	**No**
	Redbreast tilapia (Coptodon rendalli)	**140**	**3.47**	**LC**	**No**
	Cross (Oreochromis machrochir & Oreochromis andersonii)	100	**2.48**	**N/A**	**N/A**
	TOTAL	4040	**100**		

Seven species were captured during experimental fishing at Makaba, belonging to 4 families, namely *cichlidae, cyprinidae*, clariidae and mormyridae (table 4-19, fig 4-6). During the runoff season, the fish migrates with the flow over the spillway into the downstream environment. The CpUE was computed at 0.4kg/100 m net / hr. During interviews with the MDC, presence of other species in the dam, was brought to light. These included Butter catfish (*Schilbe intermedius*) LC, Three spotted tilapia (*Oreochromis andersonii*) VU, Greenheaded Tilapia (*Oreochromis machrochir*) VU, Banded tilapia (*Tilapia sparmanni*) LC and Thinface largemouth (*Serranochromis macrocephalus*) LC. As can be noted, all the species are of Least Concern except: *Oreochromis andersonii* (VU) and *Oreochromis machrochir (VU)*.

Sharptooth catfish *(Clarias gariepinus)*

Bulldog *(Marcusenius macrolepidotus)*

Red breasted tilapia *(Coptodon rendalli)*

Dashtail barb *(Barbus poechii*)

Figure 0-12: Pictures some fish species captured during fish survey

In Zambia, *Oreochromis andersonii* occurs in the upper Zambezi, as well as the Kafue, occasionally also recorded from the Middle Zambezi (Skelton 2001). Insufficient data are available on the apparent declines in abundance, but anecdotal evidence suggests a major decline in stocks on the Barotse floodplain since the 1960s as a result of heavy fishing pressure (IUCN, 2021). The rapid spread of alien *O. niloticus* especially through the Kafue system has also been noted as a threat to this species (IUCN, 2021, Tweddle et al. 2004). With respect to its biology and ecology, adults of *O. andersonii* are found mainly in deeper pools and main river channels. Juveniles and sub-adults are found in a variety of habitats in rivers and floodplain lagoons, large open swamps, and, more rarely small tributaries of the rivers. Feeds on detritus, diatoms and zooplankton. Males excavate large, saucer-shaped nests, females mouth brood the eggs and fry. Multiple broods are raised during the warmer months (IUCN, 2021). Lives for up to 11 years (IUCN, 2021). At Makaba dam, even after enhancing dam integrity via rehabilitation, growth in terms of population of this species is likely to be impacted negatively by presence of *Oreochromis niloticus* and a

projected upscale in fishing, which will unfold on account of increased human population around the dam upon rehabilitation.

Green-headed tilapia (*Oreochromis machrochir*) is a common and widespread species in Zambia. Its presence has been registered at Upper Zambezi, Kafue River, Lake Bangweulu as well as Chambeshi River (IUCN, 2021). Found in quiet waters along river margins and backwaters, floodplains and impoundments (Skelton, 2001, Tweddle et al., 2004). Feeds mainly on microscopic foods such as algae, especially diatoms and detritus. Females mouth brood eggs and fry. Breeds in summer, nests grounded into arenas (IUCN, 2021). *Oreochromis machrochir*is threatened by alien species Nile Tilapia (*Oreochromis niloticus)* and is displaced by it in areas where the two species occur together (IUCN, 2021). Presence of Nile Tilapia and an anticipated rise in fishing after the dam is rehabilitated, could impact negatively on the population of this species at Makaba.

Invertebrates

A total of 11 macroinvertebrates were encountered in the field (Table 4-20). Some of the macroinvertebrates are important by being links in the food web between the producers and higher consumers such as fish.

Table 0-20: Invertebrates

English name	Scientific name	IUCN status
Dragon flies	*Anisoptera sp.*	DD
Horse fly	*Tabanus bovinus*	DD
Mosquito	*Aedes sp*	DD
Whirligig beetles	*Gyrinus natator*	DD
water boatman	*Corixidae sp.*	DD
water strider	*Gerridae sp*	DD
Mayfly	*Baetidae*	DD
Crab	*Potamonautidae sp*	DD
Snails	*Gastropod asp*	DD
Leeches	*Hirudinea*	DD
Worms	*Lumricina*	DD

Aquatic flora

Six species of aquatic flora were encountered during this assessment (Table 4-21). Aquatic flora is critical to the health of an ecosystem. It provides food, shelter and breeding sites for some fauna (Tsugi & Muzungilwa, 2002). The species smartweed had formed a blanket-like thicket covering the surface of the dam. If it continues with this trend, it's likely a significant part of the reservoir could be affected. This could have far-reaching consequences on the whole ecosystem.

Table 0-24: Aquatic flora

English name	Botanical name	IUCN STATUS
Bullrush	*Typha angustifolia*	LC
Water primrose	*Ludwigia peploides*	LC
Water lilly	*Nymphaeaceae sp*	LC

Giant reeds	Phragmites sp.	LC
Smartweed	*Polygonum pensylvanicum*	LC
Cattail	*Typha*	LC

Evaluation of Impact Significance

Using the criteria explained in subsection 3.1.3 of this report, the potential impacts that the proposed projects may have on the biodiversity in the area were evaluated and reported in Table 4-22. The unmitigated values are shown below. It is anticipated that the impact significance will be lower once the proposed mitigation measures in the BMP are applied.

Table 0-25: Impact evaluation and reporting

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
1.0. TERRESTRIAL											
Site Preparation and Construction Phase											
Impacts on Terrestrial Biodiversity											
Increased clearing of flora for site preparation and access roads	Loss of Indigenous flora species/reduction in population i.e. stocks per area	Paving way or creation of space for access roads, setting up of construction camp as well as excavation of laterite (borrow pits) for construction works will certainly demand for clearing of vegetation in certain locations of the site	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium
	Habitat fragmentation	Creation and/or rehabilitation of access roads, construction camp and setting up of working or operational areas will further fragment the already fragmented habitats on site	Rare	Likely	Local	Long	Low	Negative	Direct	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
	Loss of habitats and associated fauna	Vegetation clearing will result in loss of habitats for the fauna observed on site - birds, insects (invertebrates), mammals (mainly hares and mice) as while as reptiles (snakes and lizards) on site. Birds may also lose nesting trees. If not checked, this may consequently result in loss of fauna	Rare	Certain	Local	Long	Low	Negative	Direct	Medium	Medium
Increased noise levels	Disruption of fauna activities	Noise from heavy construction machinery (vehicles), increased number of people on site and general workings on site will likely unsettle or disturb the fauna. Sleeping schedules, feeding movements and resting time may be affected in this regard	Rare	Likely	Local	Medium	Low	Negative	Direct	Low	Low
Increased vehicle-fauna collisions	Injury or mortality of fauna	Increased vehicular movement in the project area of influence may potentially result in collision with fauna on site that is not accustomed to this situation.	Rare	Unlikely	Local	Mediu	Low	Negativ e	Direct	Low	Low
Increased risk of hunting and trading in wildlife	Reduced fauna population	If in-migration occurs as a result of project implementation it will likely increase demand for food including game meat. This may increase the risk of hunting wild game for meat. For the same reason, trading in wildlife may increase	Rare	Unlikely	Provincial	Medium	Low	Negative	Indirect	Low	Low
Increased demand for medicinal use of flora and fauna as a result of In-migration	Increased exploitation of medicinal biodiversity in the project area of influence	Because of the increased population resulting from in-migration, the demand for medicines from flora and fauna is also likely to increase. This is likely to be the case because of lack of hospitals and clinics in the project area of influence	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Low	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Increased demand for firewood or wood based fuels	Debarking Cutting down of trees	Pressure on trees will increase with the increase in demand for firewood and wood based fuels which will be as a result of increased number of people in the area (in-migration)	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Low	Low
Impacts on Terrestrial Habitats											
Destruction of existing habitats on site	Fragmentation and depletion of habitats	Project activities such as setting up of camp site, creation of access roads, creation of working area and claiming of laterite from borrow pits will contribute to the fragmentation and depletion of habitats on site	Rare	Likely	Local	Long	Low	Negative	Direct	Medium	Medium
	Reduced value or integrity of habitats	Mismanagement of project activities can result in contamination of habitats. These activities include handling of hydrocarbons (fuel, oils and hydraulic fluids), industrial and domestic waste can also contribute to this impact. If not properly handled, hydrocarbons and different streams of waste can further reduce the value of habitats on site	Rare	Likely	Local	Medium	Low	Negative	Direct/Indirect	Medium	Medium
	Introduction of Invasive species and pathogens	There is a possibility that Invasive plants and seeds may be accidentally or intentionally introduced into the project area of influence by workers through clothing, vehicular movements, and as ornamental plants. In case of fauna, introduction may be mainly through pets	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Medium	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Impacts on Biophysical Environment											
Increased risk of fire occurrences	Reduced habitats/ecosystems value and increased risk of injury or death of flora and fauna	The presence of humans on site carries with it the risk of bush/forest fires as a result of cooking, smoking, arson as well as accidents. The results fires can negatively affect both habitats and biodiversity species on site	Rare	likely	Local	Medium	Medium	Negative	Indirect	Medium	Medium
	Injury or mortality of fauna		Rare	Likely	Local	Short	Low	Negative	Indirect	Medium	Low
Operations Phase											
Water Availability											
Increased water harvesting or storage in dam	Increased availability of water	Remedial works will increase the efficiency and capacity of the dam to hold water. This will make more water available for flora and fauna all year round. Stored water will also contribute to the charging of ground water system	Frequent	Certain	Local	Long	High	Positive	Direct	Medium	High
Dam Failure											
Risk of dam failure	Mortality or injury to flora and fauna	Dams always have an inherent risk of wall collapse. Even in the case of Makaba Dam, this may happen. In case of occurrence this may kill or injure flora and fauna downstream	Rare	Unlikely	Regional	Long	High	Negative	Direct	High	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
2.0. Aquatics											
Site Preparation and Construction											
Compromised aquatic habitats for fauna and loss of breeding areas	Clearing vegetation	Creation of access roads, setting up of construction camp, clearing dam area of vegetation during rehabilitation, could contribute to an increase of siltation within aquatic habitats.	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium
Pollution of water Loss of noise quality	Stresses flora, fauna and habitats	Some materials used during site preparation and construction could pollute the water in the dam During construction, there will be an assortment of machinery operating, and an increased number of people. Ultimately, this could increase noise levels (pollution) in the area. This could stress some lifeforms	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium
Increased fishing pressure	Reduced fish population	Project likely to increase number of people in the area. This could ultimately translate into increased demand for food items such as fish.	Rare	Unlikel y	Provinc	Mediu	Low	Negati ve	Indirec	Mediu	Low
Increased demand for water	Compromised aquatic habitat	Construction is a water-demanding task. Further, the construction workers will need water for personal use.	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Medium	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Increased habitat contamination by Hazardous waste	Loss of flora and fauna, degraded habitats	Some by- products of construction work, could be hazardous. And if they are disposed in water, unintentionally r intentionally, they could degrade habitats, cause diseases and in some cases mortality to fauna and flora	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Medium	Low
Operations Phase											
Increase in populations of flora, fauna including species of conservation concern	Populations of flora & fauna to increase, and habitats enhanced	When the dam is fixed, it will operate efficiently. Consequently, habitat integrity is enhanced. This could ultimately impact positively on the populations of flora and fauna The dam provides enough water all year round and an environment for species of conservation concern to thrive. The water body has more life forms than the dambos or streams	Rare	Certain	Local	Medium	Medium	Positive	Direct	Medium	Medium
Habitat pressure caused by the dam	Increased fishing, irrigation and livestock activities causing overgrazing and fishing activities around the dam	When the dam is repaired, it will operate efficiently. This could trigger an increase in fishing, irrigation and livestock activities around the dam leading to an increase in vegetation loss, causing siltation which will affect the dam	Frequency	Certain	Local	Medium	Medium	Negative	Direct	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Maintained environmental flows downstream and protected upstream and downstream dambos and the dam habitats	The downstream flows will continue during the runoff season in relation to the design	The flows will be maintained as per the design and storage ratios. The habitat protection is part of the training programme for DMC. Once these are protected the biodiversity in the dam will be sustained. Species of conservation will be protected and will have conducive habitats to live in.	Rare	Certain	Regional	Longterm	Medium	Positive	Direct	Medium	Medium
Increase in weeds choking the reservoir	Smartweed has formed a blanket-like thicket within the reservoir. It could eventually limit amount of light penetrating the surface of the water in the reservoir	When the dam is rehabilitated, and functioning better, this could facilitate further spread of this weed	Rare	Certain	Local	Medium	Medium	Negative	Direct	Medium	Medium
Increase in water pollution	Chemicals used for agriculture and loose soils from fields may run into the waters	Increased chemical pollution from irrigation practices which can lead to algae growth and eutrophication. Sedimentation due to soil erosion resulting from farmlands and agriculture land tilling methods around the dam, upstream and downstream	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Medium	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Decommissioning											
Settlements /infrastructure downstream may be inundated and damaged	Loss of flora and fauna, infrastructure. And unfortunately, there could loss of human lives	Decommissioning could happen if there is a desire to reconstitute the environment. It involves well thought out plans to reinstate the initial river course by removing the weir	Rare	Unlikely	local	Medium	Low	Negative	Indirect	Medium	Low
Increased ecological integrity	Increase in the life forms populations in the dam	The maintenance of the dam will ensure increased habitat integrity and populations of aquatic biodiversity	Frequ	Certai	Local	Mediu	High	Positiv	Direct	Mediu	Mediu
Loss of species of conservation concern	Overfishing	Overfishing and use of unsustainable fishing methods can deprive the waters of fauna species such as species of conservation, plankton and invertebrates. The levels of vulnerable species such as *O. machrochir* are at risk due to the presence of the invasive fish species, *O.niloticus*	Rare	Unlikely	local	Medium	Medium	Negative	Direct	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Removal of weir could lead to severe losses of water, fish, other lifeforms from the dam compromising livelihoods especially for those using the dam for fishing and agriculture	Loss of flora and fauna, infrastructure.	Decommissioning could happen if there is a desire to reconstitute the environment. It involves well thought out plans to reinstate the initial river course by removing the weir	Rare	Unlikely	local	Medium	Low	Negative	Indirect	Medium	Low

Impacts Summary

Terrestrial Biodiversity Environment

Negative Impacts during rehabilitation works include:

- Vegetation clearing for site preparations
- Loss of fauna due to vegetation clearing and activities on the site
- Fragmentation of habitats
- Reduced integrity of habitats
- Introduction of Invasive species and pathogens

Positive Impacts during operation and maintenance include:

- Increased water availability for fauna growth

Negative Impacts during operation and maintenance include:

- Vegetation clearing due to anthropogenic activities
- Loss of fauna due to vegetation clearing
- Possible deterioration of water quality downstream due to biocides that may be used during irrigation agriculture
- Fragmentation of habitats
- Reduced integrity of habitats
- Introduction of Invasive species and pathogens

Aquatic Biodiversity Environment

Positive Impacts during rehabilitation works include:

- Increased ecological integrity leading to increase in the life forms populations in the dam

Negative Impacts during rehabilitation works

- Compromised aquatic habitats and breeding areas for fauna through vegetation clearing
- Pollution of water which stresses flora, fauna and habitats
- Increased demand for water compromising aquatic habitat
- Loss of species of conservation concern due to construction works and illegal fishing methods by the contractor

Positive impacts during operation and maintenance include:

- Increase in populations of flora, fauna; when habitat integrity is enhanced
- Maintained environmental flows downstream and protected upstream, downstream dambos, and the dam habitats- the downstream flows will continue during the runoff season in relation to the design

Negative impacts during operation and maintenance include:

- Compromised aquatic habitats for fauna due to overgrazing and increased vegetation clearing
- Pollution and sedimentation of water due to increased cattle use of the dam, which may stress flora, fauna and habitats in the dam and downstream
- Increased fishing pressure which may reduce fish population
- Possible deterioration of water quality downstream, upstream and in the dam due to biocides that may be used for agriculture and soil erosion due to irrigation and farming methods
- Loss of species of conservation value due to invasive species, overfishing and unsustainable fishing methods

- In case of maintenance failure and dam failure, downstream habitats may be inundated and damaged with loss of flora and fauna.

Concluding Impact Statement

Makaba Dam provides a permanent water body on a stream, which is a small seasonal tributary of the Munyeke River in the Kafue River system. Situated towards the upper end of the catchment, the dam spills regularly in the wet season. Terrestrial and downstream aquatic habitats in the dam's area of influence have been significantly impacted over the years (decades) by subsistence cultivation and grazing of cattle. The dam itself has had little negative impact on the biodiversity of the stream and downstream river system. There are no aquatic or terrestrial species of conservation of significance that have been affected by the regulation of flow nor that are expected to be affected. Since the stream is seasonal and at the upper end of the catchment, there are no migratory fish movements of significance. The dam does not pose a barrier effect to the fish population. The two fish species listed on the IUCN Red List that were found during the study occur primarily because of the permanent water provided by the dam. However, the major threat to these species, the Nile tilapia, which has been introduced into the Kafue River system, is present near and in the dam impoundment.

While the habitat integrity of the stream downstream of the dam is lower than the upstream reach, this does not appear to be related to habitat transformation caused by sediment settling in the dam – there is no significant increase in downstream erosion caused by the stream that could be attributed to erosive waters. The main reason for poor habitat integrity downstream appears to be the practice of farming in the dambos and general habitat degradation in the surrounding areas and not attributed to the dam's impoundment.

Since the dam was first built 20 years ago it is unlikely that the remedial works will encourage additional cultivation or change the current patterns of stock use that have existed over many years. Key management requirements are to continue efforts to improve catchment conditions, particularly around the perimeter of the dam, by managing overstocking and discouraging cultivation in the seasonally wet dambos and riverine areas. This will be the responsibility of the nominated dam committee, with assistance and support from the Ministry of Agriculture, Forestry and Fisheries and DMC. Together with control of overfishing, better catchment management will assist in stabilizing the available aquatic resource for sustainable use by local communities.

BIODIVERSITY MANAGEMENT PLAN (BMP)

This site specific BMP for Makaba Dam has been developed in this section and Appendix 8 –Habitat Management to guide management of biodiversity in the project area of influence. It is based on the ecological assessment detailed in the preceding sections of this report. The ecological assessment identified the ecosystems (habitats) as well as the flora and fauna present in the project area of influence. It also gives information on the extent of potential impacts anticipated. Information gathered in the ecological assessment was used for the preparation of this BMP.

Objectives of the BMP

The main objectives of the BMP are to provide a structure to manage impacts according to the mitigation hierarchy, and to provide a roadmap for the implementers of the mitigation measures.

Specific objectives:

- Compliance with national regulations and international guidelines and/or standards regarding biodiversity management;
- Address of biodiversity risks identified through an ecological assessment of the project area of influence; and
- Remediation of impacts of the initial works on the dam

Scope of the BMP

This BMP only covers the defined area of influence for Makaba Dam. Further, its focus is on the management of potential impacts of the proposed dam works as listed in subsection 1.4 and 4.3 of this report.

Table 0-26: Biodiversity Management Plan

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
1.0. SITE PREPARATION AND CONSTRUCTION PHASE						
1.1. TERRESTRIAL						
Areas or Habitats of Special Interest						
1.1.1	Increase in disturbed habitats of interest	To avoid or prevent the destruction of areas of interest.	The contractor on site will not undertake any construction activities, clear or cut any trees within 50m radius of a colony of *Ficus brachylepis* and *Parinari curatellifolia* located on the upstream side of the dam at coordinates S16.10486^0 and E026.84497^0. This area hosts a colony of bats, *Epomophorus crypturus* and *Epomophorus wahlbergi*. *Ficus brachylepis* provides shelter while *Parinari curatellifolia* provides fruit (food) for the colony of bats. Riverine buffer zone will not be disturbed (Appendix 8-dam and dambo management).	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
			The contractor will not perform any activities in the identified two Musuku, *Uapaca kirkiana* forests at coordinates S16.10493^0, E026.84506^0 and S16.09949^0, E026.85435^0. These areas provide fruits (masuku) to the local communities and the variety of fauna within the project area of influence.	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
			Contractor employees, DMC and community members will be sensitized on the location and importance of preserving the areas of interest marked for conservation.	Beginning of construction works	On-going	UNOPS and DMC
Indigenous Flora						
1.1.2	Increase in flora clearing for site preparation and	To avoid and where not feasible minimize the loss of indigenous	The contractor will ensure that vegetation clearing is subject to approval by the Project management team or Manager on	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
	access roads	vegetation	site to avoid unnecessary flora loss. Flora management will be included in the sites' method statements (refer to ESMP).			
			The contractor will use old site access roads as they are still open. Only in instances where existing access roads need widening will the necessary clearing be done. This measure will ensure avoidance of unnecessary vegetation clearing. Roads will not be close to riparian buffer zones/ water bodies (Appendix 8- dam and dambo management).	Mobilization	End of construction works	Contractor Supervision- UNOPS
			Whenever possible e.g. at camp sites, the contractor will ensure that trees will be cut at knee height to promote coppicing at the end of the project.	Mobilization	End of construction works	Contractor Supervision- UNOPS
		Avoid use of indigenous wood/timber	The contractor will not use indigenous timber/wood for construction and related works on site as this will not be allowed. When timber is required, it will be procured from licensed pine and/or eucalyptus dealers.	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
			The contractor will sensitize and discourage its employees from using Charcoal and firewood on site. Instead alternatives such as gas stoves will be promoted.	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
1.13	Increased habitat loss by the introduction of Invasive flora species	Avoid and/or prevent the introduction of invasive species	The contractor will not allow the planting or seeding of alien or foreign flora species on site. To this effect, all employees on site will be sensitized.	Beginning of construction works	Project closure	Supervision- UNOPS
			The contractor will implement an alien invasive species prevention protocol to prevent the introduction and transfer of	Beginning of construction works	Project closure	Contractor and UNOPS Supervision- UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			invasive plant species. This will include the avoidance of affected areas by staff and vehicles where possible and wash down procedures for Project vehicles that are suspected to have been in areas infested with invasive species.			
			The contractor will ensure that only non-invasive local plant species are used for revegetation efforts under the project	Beginning of construction works	Project closure	Contractor Supervision- UNOPS
		To control the spread of exotic *Euphobia, Lantana camara* and *Helianthus tuberosus* on site	UNOPS will train the DMC on the procedure and/or develop a programme for uprooting *Lantana camara* and *Helianthus tuberosus* which have infested the project area of influence.	Beginning of construction works	Project closure	UNOPS and DMC
Fauna						
1.1.4	Injury and/or loss of fauna	To preserve fauna in and around the project area of influence	The contractor will not allow or permit hunting or killing of any wildlife on site. Hunting will constitute a serious breach of contract and will be reported to relevant authorities. Fauna management will be included in the sites' method statements (refer to ESMP).	Beginning of construction works	Project Closure	Contractor, ZAWA, Traditional Authorities and DMC Supervision - UNOPS
			The contractor will avoid clearing/cutting down of *Acacia* trees in riparian habitats and on the edges of dambos for any purpose. This is because *Acacia* trees in the riparian habitats are mainly used for nesting by indigenous birds.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor will ensure that active bird nests are not damaged during site preparation and construction activities. As far as possible tree and scrub clearance will not be undertaken during the breeding season (March to August inclusive). Should clearance during this	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			time be necessary a preclearance nesting bird check of the vegetation to be cleared will be undertaken by the Biodiversity Specialists and a decision on whether to move the nest or defer the clearance will be made by the Biodiversity Specialists.			
1.1.5	Increased vehicle collision leading to injury or mortality of fauna	Avoid collisions of vehicles with fauna on site	The contractor will • Provide driver awareness and training; • Enforce speed limits; • Restrict vehicle and machinery operation to daylight hours to avoid collisions with nocturnal and crepuscular fauna • Report any collision, document species affected and area of occurrence for record keeping and development of better abatement strategies.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
1.1.6	Increased disturbance or disruption of fauna activities	To avoid disturbance of nocturnal fauna on site	The contractor will restrict construction and related works to day time (6AM – 6PM). Night working and the use of excessive artificial lighting will not be permitted to avoid adverse impacts on nocturnal and crepuscular fauna observed on site. Strong lightning sources may also disturb migration or night movement of certain species.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			When there is need to use lighting at night, the contractor will ensure that Non-UV sources of lighting are utilized so as not to attract the nocturnal insects and thus other fauna that feed on them. This will help to avoid the risk of predation competition and high mortality of insects.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
		To avoid disturbance of	To reduce noise on site, the contractor	Beginning of	Project	Contractor

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
		fauna on site during day time	will: • Service all equipment and vehicles in line with manufacturers specifications; • Not allow idling of vehicles on site and unnecessary honking; • Sensitize employees on the need to minimize noise on site	construction works	Closure	Supervision - UNOPS
Habitats						
1.1.7	Increased habitat fragmentation	Avoid further fragmentation of habitats	The contractor will not create new access roads on site. Instead, old ones will be rehabilitated for continued use.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
	Reduced integrity, and extent of habitats	To maintain the natural extent of the dambos in project	The contractor will not carry out any construction and related project activities within dambos and fruit forests on site. Coordinates for dambos are presented in Appendix 5.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor will set the construction camp site at least 100m from the nearest dambo and the riverine. It is strongly recommended that the old camp site area be utilized even this time around.	Beginning of construction works	Project Closure	UNOPS and DMC
			The DMC and UNOPS will ensure that there are no agricultural activities within identified dambos, fruit forests and along the riverine	Project mobilization	On-going	Traditional Authority and DMC
1.1.8	Loss of integrity of the terrestrial habitats	To preserve the integrity of the vegetation on site	The contractor will carry out construction works such as cement mixing in already disturbed areas. Preferably those areas utilized during the initial construction works should be used whenever possible.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
			To minimise risk of pollution, the contractor will:	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			• Store all hydrocarbons including fuels, used oils, new and used oil filters and grease in designated places fitted with spillage protection mechanisms such as bunding and impermeable flooring • Train employees handling these materials in material handling and spill prevention			
1.1.9	Increased fire outbreaks	To avoid outbreaks of bush or forest fires	UNOPS and the contractor will not allow bush burning and or open fires in forested, riparian zone or vegetated areas. Employees will be sensitised to this effect.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
			The contractor will sensitise employees on the dangers of forest fires to both humans and the ecosystem and how to avoid them.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
Training						
1.1.10	Increased knowledge	To capacity build the contractor's employees in BMP implementation	The contractor will sensitize or train all its key employees on the importance of this BMP, its contents and how best to implement it and their roles.	Project mobilization	Project closure	UNOPS
		To sensitize or train employees and local community members on Biodiversity management	UNOPS will offer biodiversity management training to contractor employees and the locals. This training will include sensitization on: • flora and fauna present in the area • Importance of flora and fauna present within in the project area of influence	Project mobilization	Project closure	UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			• Contents of this BMP, its implementation and roles of community and employees • Sustainable management of the water dam on site • Identification and Handling of key invasive species such as *Euphobia*, *Lantana camara* and *Helianthus tuberosus* • Roles of community members on biodiversity management			
1.2. AQUATICS (SITE PREPARATION AND CONSTRUCTION PHASE)						
1.2.1	Loss of vegetation by clearing	To ensure that clearing of vegetation is avoided at all costs or alternatively, done at a minimal level to maintain its integrity that of the habitats	The contractor will avoid unnecessary clearing of vegetation. Where this is not feasible, the contractor should ensure that clearing of vegetation is kept at a very minimal scale.	Beginning of construction works	End of construction works.	Contractor Supervision - UNOPS
1.2.2	Increased pollution and siltation of water	To ensure that pollution, soil loosening and siltation is controlled	The contractor will carefully handle materials that have a potential to cause pollution. Work sites will control soil erosion and prevent soil loosening activities. Solid waste will be disposed of in a matter prescribed by ZEMA and the local town council. The contractor will maintain buffer zones (Appendix 8- dam/ dambo management).	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
1.2.3	Increased fishing pressure that could lead to a reduction in fish population	To avoid depletion of fish population on account of heightened fishing pressure	The DMC collaborating with other stakeholders (Department of Fisheries, Ministry of Livestock and fisheries, Traditional authorities, fishers) will issue fishing passes to fishers on rotational basis. This should be informed by research as regards the standing biomass of fish at	Project mobilization	On -going	• DMC • Traditional leaders • Fishers • Department Of Fisheries

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			any particular time. Further, fishers should be encouraged to harvest fish by way of employing passive gears such as hooks and lines, and gillnets. Gillnets of mesh size less than 63 mm should not be allowed to avoid capturing immature fish.			• Ministry of Livestock and Fisheries • Supervision UNOPS
1.2.4	Increased pollution of soils and water by hazardous waste products	To ensure that these are handled and disposed of in a manner that does not cause harm to habitat and its constituents	The contractor will adhere to best practices recommended by ZEMA when handling such materials. The waste will be kept in bunded facilities. The final handlers will be licensed waste management handler. Hydrocarbons will not be allowed in water. Any spill will be handled using spill kits and isolation methods. These will be disposed of in a matter prescribed by ZEMA.	Project mobilization	End of construction works	Contractor Supervision - UNOPS
1.2.5	Increased demand for water	To ensure prudent usage of water throughout construction phase and thereafter	The contractor will ensure that construction water does not compromise aquatic biodiversity requirements, ecosystem services and the environment.	Project mobilization	On-going	• Contractor • Supervision UNOPS • DMC • Traditional leaders • Department of Water resources development Water resources development
2.0. OPERATIONS PHASE						
2.1. TERRESTRIAL						
Flora						
2.1.1	Vegetation restoration	To revegetate the area in the vicinity of the dam	DMC and IDSP will initiate revegetation exercise to restore flora in cleared areas on the peripheral of the dam within 500m.	Operations Phase of the project	On-going	DMC and UNOPS Supervision – UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
		To promote catchment management (Appendix 8)	• Exposed areas will be tilled to a depth of 20cm and top soiled were possible. The area will be seeded with indigenous trees and grass species. This will be done between November and February during the rainy season (Appendix 8- dam and dambo management) The Ministry of Agriculture, Forestry and Fisheries will implement catchment management with DMC and traditional leaders for upstream protection and dam conservation needs. Catchment management is detailed in Appendix 8.			Forestry, WARMA, Agriculture, Fisheries etc.
2.1.2	Conservation of areas of interest	To preserve the marked areas of interest.	After handover of the dam, the DMC will continue to preserve/manage the marked areas as itemized in part 1.1.1 of this BMP.	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS
Fauna						
2.1.3	Conservation/management of fauna on site	To conserve/manage fauna within the dam's area of influence	DMC in collaboration of the Local authorities will continue implementing fauna management actions during the operation phase of the dam. These measures will include: • Prohibition of hunting • Prohibition of tree cutting within the vicinity of the dam • Prohibition of agricultural activities within dambos and sensitive habitats within the project area of influence • Continued sensitization on the benefits of flora and fauna conservation	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
Invasive Species						
2.1.6	Increase in invasive flora species management	To Prevent colonization of project area of influence by invasive species	The contractor will ensure that these are properly removed during works to avoid further migrations and dispersion. The methodology will be approved by the Engineer UNOPS will train the DMC and selected local community members on the implementation of invasive species management	Project Construction phase	Completion of training	Contractor UNOPS DMC
Demobilization						
2.1.7	Increase in site disturbances and aesthetics effects	To leave the site in the initial or better state relative to the baseline	At the end of construction works, the contractor will • remove all equipment and structures from construction camp site; • turn over the soil on site to a depth of 20cm; • Re-slope to mimic the natural terrain; and • Re-vegetate with indigenous flora species	End of construction works	Demobilization	Contractor Supervision - UNOPS
			At the end of remedial construction works, the contractor will rehabilitate all borrow pits on site as described under section 2.1.3 of this BMP	End of construction works	Demobilization	Contractor Supervision - UNOPS
2.2. AQUATICS (OPERATIONS PHASE)						

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
2.2.1	Increase in populations of flora, fauna; when habitat integrity is enhanced	Providing a conducive habitat for aquatic biodiversity	The contractor will rehabilitate the dam which is a habitat for aquatic biodiversity and will protect habitats during works. DMC will be trained in proper sustainable fishing methods and dam protection. Protection of the dambos by the DMC and community by using allowed fishing methods and protecting their integrity.	End of construction works	Demobilization	• DMC • Ministry of fisheries & Livestock • Department of National parks and wildlife • Traditional leaders • UNOPS-Supervisor
2.2.3	Spread of the smartweed	Limit spread of smartweed	DMC working in collaboration with other stakeholders, will physically remove the smartweed in the reservoir.	Project mobilization	On-going	• DMC • Supervision - UNOPS
2.2.4	Increase in capacity building	To create awareness and educate the communities concerning the 2 threatened *tilapia* species (Green headed bream (*Oreochromis machrochir* and Three spotted tilapia (*Oreochromis andersonii*) to ensure sustainability Enhance knowledge and ability among locals and employees	The DMC collaborating with Traditional leaders, Min. of Fisheries and Livestock, UNOPS to ensure that awareness and education executed as regards sustainable harvesting of the 2 threated tilapia species. Catch and release recommended for these 2 species. The DMC working hand in hand with Traditional leaders, Ministry of Fisheries and Livestock, UNOPS to train locals, employees on matters such as dam management, biodiversity conservation and implementation of the BMP.	Project mobilization	On-going	Supervision UNOPS • DMC • Ministry of Agriculture • Ministry of Fisheries and Livestock • Traditional leaders

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
2.2.5	Increased habitat pressure caused by the dam leading to over grazing, increase in irrigation area, and fishing activities close to the dam	To reduce pressure on the area around the dam	DMC will ensure vegetation is maintained around the dam and animal feeding is away from the dam. UNOPS and Forestry will conduct catchment management training programmes that are included in the training plan (refer to ESMP). The DMC will not allow grazing close to the dam and vegetation will be maintained by preventing cattle and human activity intervening in riparian/wetland areas in order to avoid further degradation (Appendix 8- Dam and dambo management).	End of construction works	Demobilization	• DMC • Traditional leaders • Forestry • Fisheries IDSP
2.2.6	Increased pollution and sedimentation of water which stresses flora, fauna and habitats	To minimise contamination of water and loss of biodiversity	The DMC will take part in catchment management, protection of buffer zones (Appendix 8) processes and avoid tree cutting. They will implement re vegetation around the dam and prevent soil erosion and loosening due to irrigation and livestock watering practices. The DMC will allocate specific livestock watering points that have some erosion control vegetation and rock features to minimize soil loosening.	End of construction works	Demobilization	• DMC • Traditional leaders • IDSP Forestry
2.2.7	Potential growth of algae in the dam and dambos/ wetlands upstream or downstream due	To ensure preservation of the environment and quality of water upstream, in the dam and downstream during	Local community will be trained in the best way to practice crop by the Department of Agriculture/ IDSP and in animal agriculture to ensure preservation of the environment and quality of water.	During project rehabilitation period	Operation phase	Ministry of Agriculture/IDSP

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
	to irrigation (use of chemicals) and from livestock droppings	agriculture and irrigation activities				
2.2.10	Overexploitation of fish resources which reduce fish population Loss of species of conservation concern due to overfishing and introduction of invasive species	To ensure that fish resources are sustainably utilized	The DMC will ensure that the dam should not be open access with respect to fishing. The DMC and other key stakeholders (Min. of Fisheries, traditional leaders,) should exert some form of control with respect to who can fish, where, when and how. The DMC collaborating with the DMC and traditional leaders, Min. of Fisheries and Livestock, will ensure that awareness and education executed as regards sustainable harvesting of the 2 threated tilapia species. Controlled catching and breeding season breaks will be enforced by DMC and Traditional leaders. Vulnerable fish will be protected and monitored by the Department of fisheries and DMC to avoid depletion. Fishing methods will be regulated by DMC with sustainable methods to prevent catching and destruction of eggs, invertebrates, plankton, and small fishes. The DMC and traditional leadership will ensure that biodiversity isprotected by sedimentation control and pollution prevention by the communities; and catchment management.	End of construction works	On-going	• DMC • Ministry of fisheries & Livestock • Traditional leaders

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			The DMC and Fisheries will not further introduce invasive species on the water. Indigenous species will be used for restocking.			
2.2.11	Increased education and awareness on threatened tilapia species Capacity building- Increased knowledge and ability among locals	To create awareness and educate the communities concerning the 2 threatened *tilapia* species (Green headed bream (*Oreochromis machrochir* and Three spotted tilapia (*Oreochromis andersonii*) to ensure sustainability	The DMC collaborating with traditional leaders, Min. of Fisheries and Livestock, will ensure that awareness and education executed as regards sustainable harvesting of the 2 threated tilapia species. Catch and release recommended for these 2 species. Furthermore, the DMC working hand in hand with Traditional leaders, Ministry of Fisheries and Livestock, UNOPS will train locals, employees on matters such as dam management, biodiversity conservation and implementation of the BMP.	Project mobilization	On-going	Supervision • DMC • Ministry of Agriculture • Ministry of Fisheries and Livestock • Traditional leaders
2.2.12	Maintained environmental flows downstream	To ensure downstream flows during rainy season	The UNOPS design will ensure ecological flows are continuous during the rainy season according to the dam's storage ratio. The IDSP and UNOPS will train the DMC on flow monitoring and its importance. The DMC and IDSP will monitor the flows during the runoff season. The dambos will be protected by the communities to maintain the habitats throughout the year. Protecting these habitats will ensure continuous protection of life forms and their flow during runoff seasons.	Operation phase	On-going	UNOPS –Communities, DMC

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			DMC and IDSP will monitor outlet and spillway flows DMC will ensure protection and maintenance of. The dambos and dam will be protected by conserving the features, avoiding gardens around them and siltation, using proper fishing methods, preventing invasive species, and prevention of soil erosion.			
2.2.13	Increase in practicing crop farming upstream close to the riparian zone Increase in irrigation activities downstream	To ensure that the integrity of the riparian zone upstream and downstream is sustained to forestall siltation of the aquatic habitats To reduce siltation	The DMC collaborating with Min. of Agriculture, Traditional leaders, Min. of Fisheries and Livestock, will ensure that no one is farming along the riverine. Those with farming plots along the same, have to be relocated/ provided with alternative pieces of land away from the riverine. Where they can continue farming.	Construction and operation phases	On-going	• DMC • Ministry of Agriculture • Ministry of Fisheries and Livestock • Traditional leaders
2.2.14	Increase in populations of flora, fauna; & habitat integrity enhanced	To ensure that flora, fauna and habitat are well secured	The DMC working in collaboration with other stakeholders (Ministry of Fisheries and Livestock, Ministry of Agriculture, traditional authorities, will formulate management plan to secure these resources. The plan should be reviewed time and again in tandem with changing dynamics on the ground	Project mobilization	On-going	• DMC • Ministry of fisheries and Livestock • Ministry of agriculture Traditional authorities
2.2.15	Increased infrastructure failure and sedimentation due to lack of	To ensure that sedimentation is controlled	The contractor will execute designed works with expected skill supervised by UNOPS. Afterwards, there should be regular monitoring of the dam's integrity by key stakeholders to forestall	Project mobilization	On-going	• DMC • Ministry of Agriculture • Ministry of Fisheries and Livestock

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
	maintenance activities In case of maintenance failure and dam failure, settlements/infra structure downstream may be inundated and damaged with loss of flora and fauna. And unfortunately, there could loss of human lives	To ensure dam functionality To promote maintenance activities post rehabilitation works	decommissioning. There will be adherence to the operations and maintenance manual by the relevant stakeholders as indicated in the manual. The stakeholders (DMC, Ministry of fisheries and Livestock, Ministry of Agriculture, Water resources development, Ministry of water, sanitation and environmental protection, Traditional leaders) should collectively invest efforts to ensure that the dam wall and other accompanying structures are always in a good condition. They will also implement catchment management activities over a period of time (Appendix 8).			• Traditional leaders • Water resources development department

Follow-up and Monitoring

The monitoring plan for the Project was developed to ensure the proper implementation and effectiveness of mitigation measures. Parameters or indicators to be monitored have been developed by adhering to the SMART nomenclature (scientific, measurable, accountable, reliable, and time-bound).

The aims or purposes of this monitoring plan are to determine observe the deviation from the baseline conditions of the observed biodiversity and environmental factors and assess the effectiveness of the impact mitigation/management interventions put in place; and prevent the occurrence of serious negative project impacts on the biodiversity and environment by facilitating timely corrective actions on project aspects and management interventions not yielding the intended results.

Table 0-27: Biodiversity Monitoring Plan

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
1.0 Terrestrial						
Construction Phase						
1	Loss of vegetation cover.	To avoid where possible or limit loss of vegetation as much as is possible.	The contractor will use already cleared areas where possible. Where there is need to clear, clear boundary or working area will be defines and fenced off as the only defined area where vegetation clearing will take place.	During remedial works	• Contractor • UNOPS • IDSP	Vegetation maintained in the present condition except for defined areas as demanded by project works/accessories.
			The contractor in consultation with Forest Department (FD) personnel will ensure trees are cut in such a way as to promote coppicing.	During remedial works	• Contractor working with Department of Forestry	Trees cut at knee height.
2	Loss of habitat	To ensure availability of diverse habitats for various forms of insects and animals.	The contractor will conduct a re-forestation program in areas that will lose vegetation cover inevitably during the rehabilitation works and also in areas that do not have much vegetation cover due to initial construction works.	At completion of remedial works.	• Contractor • Forestry Department • DMC	Degraded sites artificially aided to regenerate by onset of rain following completion of works.
3	Soil degradation	To restore soil organic matter and soil micro-organisms lost due to trampling and compaction by equipment and machinery during remedial measures.	The contractor will restock affected areas with miombo vegetation to allow for re-colonization of the associated biodiversity.	At completion of remedial works.	• Contractor • Forestry Department • DMC	Affected areas restocked with miombo vegetation.
4.	Loss of soil properties needed to support terrestrial	To avoid polluting the soil with spent oil (oil from the engine) and/or fuel.	The contractor will ensure that the equipment and machinery used is in good working conditions. No fuel and oil leakages. Vehicles and	During remedial works	• Contractor • UNOPS	Affected sites restored by use of oil adsorbents, with report indicating how much was used.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
			other equipment should be parked and stored in designated places when not in use.			
5.	Rehabilitation of legacy and current sites	To ensure that all impacted sites are brought back to their near original state.	The contractor will rehabilitate all impacted sites or opened up areas by providing for regeneration of vegetation in the affected areas	At the end of remedial works	• Contractor • UNOPS	Re-vegetation / Tree planting done.
Operation phase						
1.	Loss of ecosystem services provisioning	To restore the inherent ability of the miombo woodlands to provide ecosystem services such as NWFP*, ethnobotanic value etc.	The catchment management committees and DMC will conduct reforestation of the impacted areas. They will: • Promote biological diversity conservation programmes that have positive impacts on the natural ecosystems. These include bee keeping, and conservation agriculture. Additionally, promotion of NWFP (such as caterpillar, mushrooms, wild fruits etc.) through provision of ready market opportunities. This can encourage and motivate local communities to focus more on activities that are friendly to the natural ecosystem. • Conduct community awareness programmes on various issues dealing with biological diversity and ecosystem management and conservation.	During and after rehabilitation works. Monthly visits in the initial stages then quarterly after the reforested areas establish and when community structures become fully functional.	• DMC • Local traditional leadership • Ministry of Agriculture • Forestry • Catchment committee	Reforestation of cleared areas done at the onset of the rain season following completion of rehabilitation works. Fliers for community sensitization produced not more than 3 months after completion of works. One community sensitization meeting report per quarter.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
			• Implement community based natural resource management DMC will control and monitor invasive weed infestation			
2.	Loss of flora in the stream catchment areas has the potential to degenerate water resources	To ensure continued availability of water for animal watering and vegetable gardening.	The DMC will protect the stream catchment area through proper management of the forest ecosystem around the area (No cutting of trees).	During and after completion of rehabilitation works.	• Contractor • Forestry Department committee. • Local traditional leadership. • DMC	Catchment area protection sensitization programme.
2.0 Aquatic						
Construction phase						
1.	Loss of feeding and breeding grounds in the habitats	Loss of feeding and breeding grounds	The contractor will maintain any feeding and breeding grounds for aquatic life during works.	During rehabilitation works.	• Contractor • UNOPS • DMC • Fisheries	Protected breeding grounds
2.	Exotic macrophytes	To maintain the quality of water in the dam for improved aquatic biodiversity.	The contractor will remove the dense floating grassy mat that is engulfing the dam near the spillway during works with a methodology approved by the Engineer	During rehabilitation works.	• Contractor • UNOPS • IDSP	A method statement and properly removed weed. The floating weed not present in the limnetic zone of the dam by the end of the rehabilitation works.
4.	Soil erosion from disturbed areas causing siltation in the reservoir and parts of upstream and downstream	To arrest soil erosion from taking place, which smothers sediments that provide food nutrients for aquatic species.	The contractor will ensure the disturbed areas and open slopes are revegetated to arrest occurrence of soil erosion	During rehabilitation works	• Contractor • UNOPS • IDSP	No sites in the surrounding environment are opened up to soil erosion.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
5.	Increased fish abundance in the dam due to favorable breeding and feeding grounds	To ensure sustenance and improved fish stock abundance in the dam.	The DMC and fisheries will regulate fishing activities to protect the stock from overfishing.	After rehabilitations works	• Fisheries department • DMC • Local traditional leadership	Dam management by-laws drafted by completion of rehabilitation works
6.	Impacts on the species of conservation concern	To avoid any mortalities of species	The contractor will conduct robust visual observations before undertaking any works DMC and Fisheries will implement a monitoring survey of this species post-construction.	During and after rehabilitation works	• Contractor • Fisheries department • DMC	No mortalities recorded for every 6 monthly reporting period
Operation phase						
1.	Increased feeding and breeding grounds for fish once the dams are restocked with fish	To main the feeding and breeding grounds for fish and ensure sustenance of fish production.	DMC and Fisheries will protect the breeding grounds for fish by ensuring no fishing activities take place in willow waters. DMC and Fisheries will protect vulnerable fish species by monitoring the quantities and using safe fishing methods DMC will monitor and control invasive weeds	During and after rehabilitation works.	• Department of Fisheries • Local Traditional Leadership • DMC	Dam management by-laws drafted by completion of rehabilitation works.
2.	Bed modification: Low deposition of silt	To maintain reduced siltation in the dam so as to maintain diverse habitats.	DMC will maintain riparian vegetation around the dam by prohibiting cutting and farming close to the dam. DMC, Forestry and Fisheries and other stakeholders will conduct catchment management (Appendix 8)	During and after rehabilitation works.	• Forestry Department • Fisheries Department • Local Traditional Leadership • DMC	Dam management by-laws drafted by completion of rehabilitation works.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
3.	Solid waste disposal in the reservoir compromising water quality and thus affecting aquatic species due to decomposition of organic matter, depletion of oxygen in the reservoir	To keep the dam free from solid waste disposal to ensure good water quality. No debris to obstruct sunlight for photosynthetic processes guaranteeing oxygen generation in the water column for aquatic species	DMC will protect the dam from solid waste disposal by completely arresting indiscriminate disposal of waste.	During and after rehabilitation works.	• DMC • Local traditional leadership	Reports from dam committees to the District Management Committee on solid waste disposal submitted every month. Management of generated solid waste in the community close to the dam in place.
4.	Exotic macrophytes	To maintain the quality of water in the dam for improved aquatic biodiversity.	DMC will remove the dense floating grassy mat that is engulfing the dam where the stream enters the dam and any other areas it sprouts up during the operation of the dam.	During and after rehabilitation works.	• DMC • IDSP	The floating weed not present in the limnetic zone of the dam during operation.

Evaluation of monitoring

The evaluation of the monitoring programme will be on-going and as follows:

- Daily: General monitoring updates, reporting of incidents impacting biodiversity and emergency response;
- Monthly: Compilation of monitoring progress report, environmental training delivered, details on any major incidents/events, general progress of the monitoring program; and
- Quarterly: Summary report on quarterly biodiversity monitoring programs, review quarterly performance and apply adaptive management if required.

Implementation of the BMP

Step 1: Roles and responsibilities of different stakeholders for BMP implementation

Table 0-28 Roles and Responsibilities of relevant stakeholders in in BMP implementation

Name of Authority/ Entity	Key Role and Responsibility
IDSP/ Ministry of Agriculture	IDSP under the Ministry of Agriculture (MoA) bears the overall responsibility of ensuring that the implementation of the project in its planning, rehabilitation, operational and demobilization phases follows the environmental safeguards prescribed in the BMP. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the PIU of the IDSP will manage and implement the broader additional financing activities, it has contracted UNOPS to oversee and implement the remediation works of the remedial dams, including Makaba Dam. The IDSP-PIU E&S Team is responsible for all E&S aspects of the IDSP. It will supervise and monitor all E&S aspects of all activities of the UNOPS Sub-PIU and UNOPS contractor at the Makaba Dam. The IDSP-PIU will retain the primary responsibility for ensuring that environmental and social commitments for the Makaba Dam are met throughout the sub-project lifespan vis-à-vis the World Bank. • The IDSP-PIU will establish a schedule of supervision and monitoring for the BMP of the Makaba Dam. • The IDSP will have an environmental specialist who will oversee the UNOPS staff with regards to the BMP tasks. At least one additional MoA field staff member with HSSE responsibilities will be located at Makaba Dam for continuous onsite monitoring and reporting during remediation of the dam and its operation – for the lifespan of the IDSP. • The safeguards supervision includes the operationalization of the dam, during which period the IDSP personnel will be working with the respective local authorities, dam committee and local communities, in preparation for smooth handover when IDSP ceases to exist as a project. • The PIU will implement capacity building and training of local stakeholders to ensure their informed cooperation in E&S matters during the remedial works and during the operational phase of the dam as well as advising the DMC. • IDSP will implement its own monitoring and supervision activities as they apply for all activities, including the remediation of Makaba Dam. IDSP has the overall responsibility for monitoring and reporting, but is supported by UNOPS' monitoring and quality assurance

	activities. IDSP and UNOPS will jointly discuss any necessary amendments to activities, where necessary.
UNOPS/ Supervising Engineer	The IDSP-PIU has contracted UNOPS to implement the remediation sub-project of Makaba Dam under the AF, including the day-to-day environmental and social management and implementation of the measures described in this BMP. UNOPS has been tasked with the design of the remedial works and the preparation of this BMP. UNOPS will further be responsible for the preparation of the tender document and supervision of the contractor for the remedial construction works including the implementation of safeguards mitigation measures. Specifications for safeguards derived from the BMP will be included in the tender documents. Bidders receive key documentation outlining the requirements of the ESMP, as well as BMP. The bidding documents will contain a general reference to the necessity to comply with this BMP and will detail key tasks/mitigation measures/trainings, which the contractor will be obliged to undertake as part of his deliverables. Supervision will involve the management of the contractor and liaison with and reporting to the IDSP-PIU throughout the contract period. The UNOPS Sub-PIU E&S Team is responsible for the implementation of the BMP mitigation measures laid out in this BMP. Where implementation is conducted by contractors, the UNOPS Sub-PIU E&S Team supervises and monitors all E&S related aspects of the contractor's works. The environmental specialist, social specialist and ecological specialist will be involved in the environmental and social management of Makaba Dam. In addition, the team will supervise and monitor the implementation of the BMP mitigation measures by the contractor. The team will establish a regular supervision and monitoring schedule, including site visits, and will prepare and submit quarterly environmental and social monitoring reports to the IDSP-PIU. UNOPS will be responsible for and will oversee, supervise and monitor the works of the contractor, including the contractor's E&S performance. • UNOPS will ensure regular supervision and monitoring of the implementation of all mitigation measures laid out in this BMP, as well as all trainings and other required activities. • UNOPS will use the indicators all mitigation measures, as listed above in this BMP, for its monitoring activities. • A supervision and monitoring report will be prepared every month and shared with the PIU of ISDP and the World Bank. The contents of this report will include: progress of the civil works, implementation of the BMP, confirmed the supervision of the safeguards specialist on site, photos, records of works, restoration efforts, terrestrial and aquatic environments management, grievances, accidents, communication, and training, among others. • UNOPS will monitor and review all method statements prepared by the contractor to ensure that all areas that require remediation/ rehabilitation are covered and that the proposed methodologies are appropriate. • UNOPS will take measures in the case of non-compliance. It will immediately liaise with the contractor, assess the risk level, significant and severe risks will cause for suspension of works until the non-compliance has been resolved to the satisfaction of UNOPS. Any significant loss of time caused by the contractor's non compliance situations will be dealt with in accordance with the set procedures in the contract.

ZEMA	To undertake enforcement, compliance, review and monitoring of environmental assessment management plans. Visit, inspect and monitor the site or specific activities at any particular time
Government ministries and other stakeholders- Pemba district	The duty of the local authorities in the project area of influence with regards to the BMP is to coordinate with the project and stakeholders (s) on BMP commitments pertaining to site assessments, habitat management, fishing methods, re-vegetation, capacity building and training, inspections and participating in the project public outreach. The stakeholders have operation responsibilities for habitat management. The IDSP will inform the relevant offices for catchment management. The monitoring roles and responsibilities of the key parties/ stakeholders regarding the implementation of the ESMP will be communicated to relevant ministries indicated.
Contractor	UNOPS will contract the contractor after preparation of bidding documents. The selected contractor will comply with all stipulations in this ESMP for the duration of the contract. These requirements equally apply to sub-contractors. It is the contractor's responsibility to ensure that subcontractors comply and demonstrate such compliance in submittals and during verification processes by UNOPS. The contractor will engage competent full time Health, Safety, Social and Environmental staff on site to carry out Environmental and Social mitigation measures set out in the ESMP/ BMP. The Officer will be responsible for implementation and monitoring the contractor's compliance with the BMP requirements and the environmental specifications. The duties of the officer will include but not be limited to the following: a) carry out environmental including biodiversity site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to adequacy of environmental mitigation measures implemented; b) monitor compliance with mitigation and protection measures, prevention and control measures and contractual requirements; c) monitor the implementation of environmental mitigation measures; d) prepare monthly status reports for the site environmental conditions; e) advise the contractor on environment improvement, awareness and proactive pollution prevention measures; d) recommend suitable mitigation measures to the contractor in the case of noncompliance; e) carry out additional monitoring of noncompliance instructed by the supervisor; f) inform the contractor and supervisor of environmental issues, submit contractor's plans to the supervisor and relevant authorities, if required; and g) keep detailed records of all site activities that may relate to biodiversity. If pre-bid meetings, site visits and / or contract commencement meetings are carried out, the biodiversity requirements and submittals should be discussed, both for day-to-day work and for environmentally critical stages or activities. • Contractors provide details on contractor's oversight on safeguards performance; • Contractor and sub-contractors to deploy a workers' grievance mechanism to handle the concerns of their workers; • Contractor will prepare and affirm all plans and method statements required in this BMP and ESMP that affect biodiversity and habitats prior to construction activities ◦ Borrow pits and material sites ◦ Contractor emergency response plan ◦ Waste management

	• Campsite activities • Excavation works and stock piling • Sanitation and water management • Traffic management and access routes management • Biodiversity management • Training, engagement and sensitization • Contractor will work within the requirements of legislative requirements and standards • Contractor will carry out any corrective actions instructed by UNOPS and IDSP. In case of non-compliances/discrepancies, the contractor will carry out investigation and submit proposals on mitigation measures and implement remedial measures to reduce environmental impact. • Non-compliance by the contractor may cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of UNOPS. The contractor must report on all HSSE matters related to this BMP to UNOPS on a monthly basis. UNOPS will administer the monthly reports from the contractor, and will prepare its own quarterly reports, based on its supervision and monitoring activities, as well as designated UNOPS activities in this BMP to IDSP. Quarterly progress reports will include the status of the implementation of risk mitigation measures, trainings, workers' GRM, as well as lessons learnt, any adjustments made to improve E&S management and performance and corrective actions undertaken, if applicable. Quarterly reports will also be made available to the local Dam Committee and local authorities.
Local community and Dam Committee	As owners of the dams, the dam community will be encouraged to be active partners during the construction. It will be regularly consulted on a variety of issues. It will further be asked to report any misconduct by the contractor or contractor's personnel to the IDSP-PIU, through the GRM, which has been designed for the AF activities. Community members will be appointed by the dam committee to verify that the works do not cause harm to people and nature. Furthermore, stakeholder engagement, as laid out in the SEP in the ESMP, will be conducted by UNOPS, IDSP and the contractor, to ensure that community engagement informs the sub-project, that dam communities are well informed about the remedial works and the biodiversity mitigation measures undertaken. The dam is operated by a dam committee, which consists of community members. The Makaba DMC is active, consisting of three women and seven men (Refer to the ESMP). Due to the complexity of managing dams, the management structure is widened to include public agencies such as agriculture, water resources, fisheries and forestry departments as advisors and trainers. The committee has been involved during planning, construction and operation phases. The level of involvement in the maintenance and management will depend on the type of technology, the range of maintenance activities and capacity building offered to the committee. Therefore, UNOPS and IDSP have and will further inform communities of their expected obligations and contributions during consultations and training. Upon completion of the remedial works, there will be a hand-over of the management, operation and maintenance of the dam to the Makaba DMC. In order to successfully operate the dam, and limit impacts on people and environment, the dam committee members require further capacity building and training. Training will include issues such as dam safety

	management/ structural deterioration; habitat management; dam usage and best practice, biodiversity protection, erosion control and conservation (see training plan is included in the ESMP). Quarterly reports will also be made available to the local Dam Committee and local authorities. MoA has representatives at the dam who will periodically report to IDSP.

Step 2: Incident Reporting

The Contractor, UNOPS, and IDSP are required to report on any environmental and biodiversity incidents related to the sub-project activities. The contractor will form the incident investigation team and will provide incident reporting on a monthly basis to UNOPS, and UNOPS will include summaries of incidents in its regular reporting to IDSP. Any incidents classified as 'severe' must be reported to the World Bank within 48 hours.

Incident reporting will follow the management and reporting process below:

1) Initial communication
2) Classification: how serious?
3) Notification: Who? How: When?
4) Investigation: What happened? How and Why?
5) Response: Remedial actions?; Preventive actions?
6) Follow up: Is response Complete? Was it effective? Lessons?

Incidents should be categorized into 'indicative', 'serious' and 'severe' (Refer to World Bank classification of incidents in the ESMP). 'Indicative' incidents are minor, small or localized that negatively impact a small geographical area or a small number of people and do not result in irreparable harm to people or the environment. A 'significant' incident is one that causes significant harm to the environment, workers, communities, or natural resources and is complex or costly to reverse (see below for World Bank incident classification guide). A 'severe' incident causes great harm to individuals, or the environment, or presents significant reputational risks to the World Bank. Incident reports should use the format in the ESMP.

Step 3: Handover for Operation

Once construction works and trainings are completed, UNOPS and IDSP will declare the works final. The dam will be handed over to the Makaba DMC who are part of the local community and local authorities. IDSP will continually engage with the communities and local authorities throughout the lifespan of the dam.

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Appendix 1: Sample Plots Coordinates

COORDINATES FOR MAKABA DAM		
Sample Plot No	**Coordinates in degrees ˚**	
	South	**East**
1.	S 16.10221	E 026.85459
2.	S 16.10403	E 026.85130
3.	S 16.10789	E 026.84344
4.	S 16.10979	E 026.84575
5.	S 16.10887	E 026.85059
6.	S 16.10757	E 026.85230
7.	S 16.09949	E 026.85435
8.	S 16.10118	E 026.84395
9.	S 16.10493	E 026.84506
10.	S 16.10628	E 026.84209
11.	S 16.50525	E 026.83960
12.	S 16.11245	E 026.83976
13.	S 16.10089	E 026.84296
14.	S 16.09928	E 026.84782
15.	S 16.10176	E 026.85769
16.	S 16.10164	E 026.86099
17.	S 16.09870	E 026.86053
18.	S 16.09719	E 026.85520
19.	S 16.09897	E 0260.8555
20.	S 16.09753	E 026.85349

Appendix 2: Main Plot data collection form

TREE PARAMETERS DATA FORM						*FORM A*
Altitude……	**Plot No……..**	**Date……**		**Quadrant No……**		**Plot Size……..**
Centre of Plot (GPS Reading UTM) N…….. E……..		**Vegetation Type……..**				
Recorder……..						
SPECIES (TREE ≥ 5CM)	**HEIGHT (M)**	**DBH (CM)**	**CROWN SIZE** a Width	b Length	**STEM HT (M)**	**NOTES****

** Indicate any noticeable
damage, crookedness, fungal attack
browsing signs, form, fire occurrence etc.

Plant Species Identification Codes:

√ ? -- Genus identified, species uncertain; (Write GENUS name and ?)

+ / - -- Identification not sure; (Write SUSPECTED NAME and + / -)

?? – Plant not identified (Write: SPP, Id No. and Plot No.)

Appendix 3: Regeneration Plot Data Collection Form

TREE REGENERATION DATA FORM				*FORM B*
Altitude……	**Plot No……..**	**Date……**	**Quadrant No……**	**Plot Size……**
Centre of Plot (GPS Reading UTM) N…….. E……		**Vegetation Type……**		
Recorder……..				

SPECIES	COUNT	NOTES**

** Indicate any noticeable
damage, crookedness, fungal attack
browsing signs, form, fire occurrence etc.

Plant Species Identification Codes:

√ ? -- Genus identified, species uncertai (Write GENUS name and ?)

+ / - -- Identification not sure; (Write SUSPECTED NAME and

?? – Plant not identified (Write: SPP, Id No. and Plot No.)

Appendix 4: Fauna Data Collection Form

Mammals

	Species		No. Seen		Signs - write details	Other faunal species
1						
2						**Reptiles**
3						
4						
5						
6						
7						
8						
9						
10						
12						
13						
14						**Amphibians**
15						

Birds

	Species		No. Seen		Signs - write details	
1						
2						
3						
4						
5						
6						
7						**Invertebrates**
8						
9						
10						
12						
13						
14						
15						

Fire occurrence

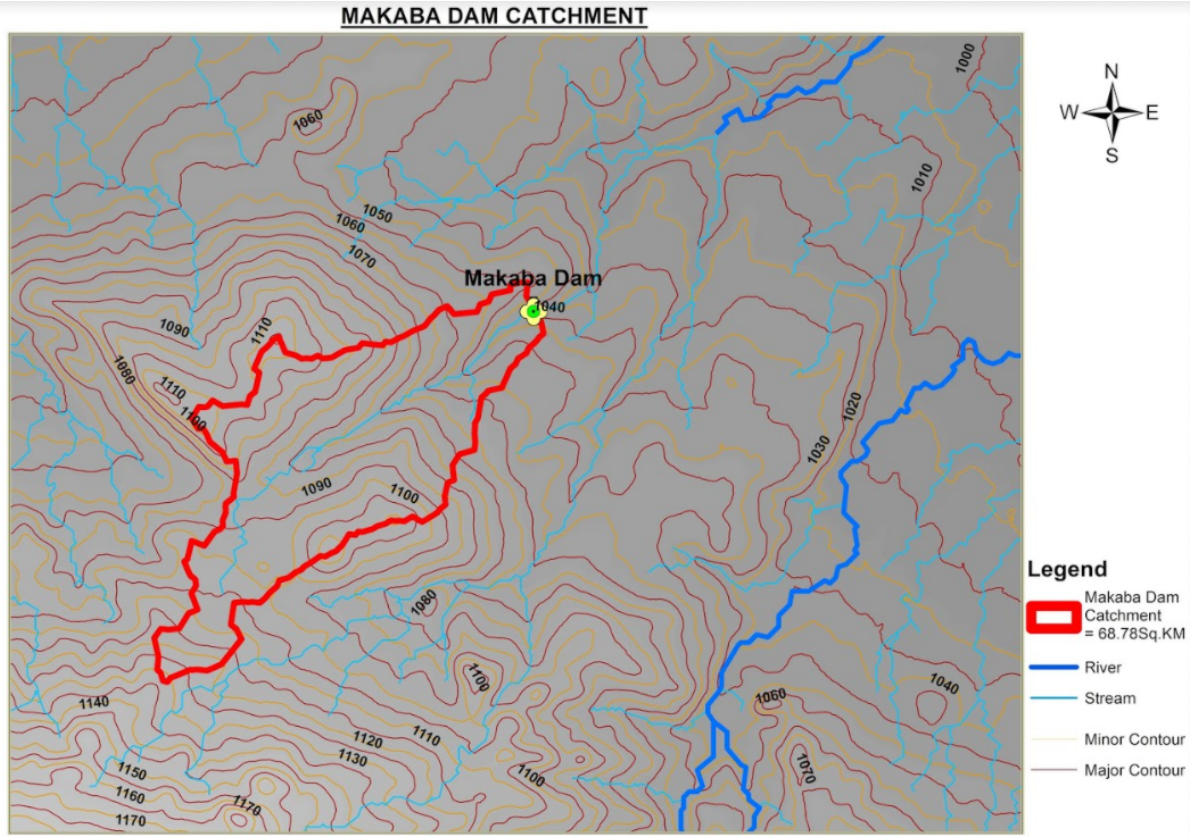
☐ Recent

☐ Old

Notes

Appendix 5: Coordinates for Dambos of Interest in the Project Area of Influence

Dambo No.	Elevation (m)	Coordinates	
		South	East
Dambo 1	1035	S 16.10676^0	E 026.84566^0
Dambo 2	1031	S 16.10497^0	E 026.84562^0
Dambo 3	1039	S 16.10950^0	E 026.84363^0
Dambo 4	1029	S 16.09981^0	E 0 26.85950^0




Makaba Dam
Dambos
Legend
Dambo
Makaba Dam
Makaba Dam
Dambo 4
Dambo 2
Dambo 1
Dambo 3
Google Earth
Image © 2021 Maxar Technologies
N
2 km

Appendix 6 Data Collection Sheet

DATA COLLECTION SHEEET
The Aquatic Biodiversity Check List for the 10 Dams in Zambia

Biodiversity Scoping

Identification of habitats

- ✓ Is the direct area of influence considered to be modified/converted, natural, or critical habitat?
- ✓ Is the indirect area of influence considered to be modified/converted, natural or critical habitat?
- ✓ What is the legal protection regime?
- ✓ Is the direct area of influence located on indigenous land?
- ✓ What are the existing drivers of habitat loss (irrespective of the dam) ?

Identification of key biodiversity features

- ✓ Is it a priority area for conservation? (existing or proposed protected area, indigenous or local communities protected areas, Ramsar sites, area with high level of endemism, presence of aquatic corridor to ensure genetic diversity, important spawning area etc.). Note: List all sites within a 50km radius from the dam.
- ✓ Are there any Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) species and/or endemic or restricted-range species within a 50 km radius from the dam ? If so, list the species and their conservation status (based on the IUCN Red List)
- ✓ Does the area support important ecological processes? (spawning site? sediment supply to a wetland downstream? fish migratory route ? etc.)
- ✓ Are there any priority ecosystem services in the area of influence that may be affected by the dam ? If so, is it critical to the livelihoods of indigenous communities?

Identification of Aquatic species

- ✓ What is the conservation status of the vertebrate and invertebrate species?
- ✓ What is the conservation status of the macrophytes?
- ✓ Is there any migratory fish species ? List those species (if applicable) and shortly describe the migratory dynamic.

Aquatic biodiversity impact assessment and management

- ✓ What are the potential impacts and risks (direct, indirect, induced and cumulative) of the dam and how it would affect the key biodiversity features (if any)? Shortly describe impacts for each project phases (construction, operation and decommissioning)
- ✓ Would the dam lead to long term declines in population of any species listed either as CR, EN, VU or NT?
- ✓ Will the project significantly affect critical natural habitats or natural habitats?
- ✓ Would there be any significant changes in the water flow that could affect the aquatic and/or the riparian habitat and species?
- ✓ Is there any residual biodiversity impacts anticipated?
- ✓ In the case of residual impacts, is there sufficient information to plan management actions required to mitigate, or compensate for this type of impacts ? Or additional baseline studies are required?
- ✓ Is it possible to improve the project's design to avoid (and if not possible, to minimize) the project's impact?
- ✓ What are the potential options for biodiversity conservation and enhancement?

Monitoring

- ✓ Is the baseline information gathered sufficient to produce standardized biodiversity indicators useful for monitoring changes in the biodiversity overtime?

SAMPLING FORM 1
FISH SPECIES

A. Length-Weight Data

To be completed at every sampling point **Sampling Day:…….**

Coordinates:…… Date:……/……/…….

Sample ID	Name of Species (common name and *Latin name*)	Number	Length (mm)	Weight (g)	Gear	IUCN Conservation status	Migratory species (yes/no)	Endemic, restricted-range specie (yes/no)
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
12.								
13.								
14.								
15.								
16.								
17.								
18.								
19.								
20.								
21.								
22.								
23.								
24.								
25.								
26.								
27.								
28.								
29.								
30.								

Sampling Form 2
WATER QUALITY

B. Physicochemical Parameters

Sampling Point …… Sampling Day:……
Coordinates:…….. Date:……/……/…….

SAMPLING POINT	DO (mg/L)	Temp (C^0)	pH	Cond mS/m	Sech. reading	TDS	Total hardness	Alkalinity	Turbidity
Values of references									
downstream									
Upstream									
Mid of the dam									
At the weir									

Sampling Form 2

C. Aquatic plants

Sampling point …… Sampling day:……
Coordinates:…….. Date:……/……/…….

S/#	Species	Monocots	Dicots
Emergent			
Submerged			
Free floating			

D. Macroinvertebrates survey

Order	**Sub/Family**	**English name**	**Comments**
Odonata	Libellulidae	Dragonflies	
	Aeshnidae	Dragonflies	
Diptera	Tabanidae	Horseflies	
	Culicidae	Mosquitoe	
	Chironomidae	Midges	
Coleoptera	Gyrinidae	Whirligig beetles	

Hemiptera	Corixidae	Water boatmen	
	Gerridae	Pondskaters/water striders	
Ephemeroptera	Baetidae	Mayflies	
Crustacea	Potamonautidae	Crabs	
Gustropoda	Thiaridae	Snails	
Any other species			

Appendix 7 – Water Analysis Results for water samples collected at Makaba Dam

	Makaba Dam Wall	Makaba Dam Mid	Makaba Dam Downstream	Makaba Dam Entry	Makaba Dam Upstram
Sampling date	**15.04.2021**	**15.04.2021**	**15.04.2021**	**14.04.2021**	**23.04.2021**
Parameter					
pH	6.78	6.64	6.39	6.39	6.52
Conductivity (µs/cm)	48	75	212	77	214
Sulphates (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrates (as NO_3–N mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01
Alkalinity (as $CaCO_3$ mg/l)	44	56	110	42	90
Total Dissolved Solids (mg/l)	112	115	116	112	114
Ammonia (as NH_4-Nmg/l)	<0.01	<0.01	<0.01	<0.01	<0.01
Phosphates (mg/l)	<0.01	0.30	<0.01	<0.01	<0.01
Total Suspended Solids (mg/l)	5.2	4.3	5.1	4.6	4.3
Chemical oxygen demand (as mg O_2/l)	3	3	4	3	3
Chlorides (mg/l)	23.0	17.0	30.0	15.0	10.0
Turbidity (NTU)	23.00	14.90	21.60	17.20	17.70
Hydrocarbons (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005

Tests carried out in conformity with " Standard Methods for the Examination of water and Wastewater APHA, 1998".

Plankton composition at Makaba Dam

No.	Phytoplankton	Zooplankton
1	*Phacus triqueter*	*Brachionus falcatus*
2	*Trachelomonas*	*Diaphanosoma brachyurum*
3	*Volvocina sp*	*Brachionus angularis*
4	*Navicula* sp.	*Brachionus calyciflorus*
5	*Pediastrum* sp.	*Brachionus budapestinensis*
6	*Synedra*	*Kerratella valga*
7	*Microcystis novacekii*	*Cyclops*
8	*Euglena* sp.	*Diurella stylata*

9	*Microcystis* sp.	*Trichocerca cylindrical*
10	*Distigma* sp.	*Nauplius*
11	*Urothrix*	*Asplanchna herricki*
12	*Anabaena*	*Simocephalus vetuloides*
13	*Sphacroplea annulina*	*Cydorus sphaericus*
14		*Ceridaphania cornuta*
15		*Macrothrix spinosa*
16		*Moina micrura*
17		*Daphnidae*
18		*Asplanchona sp*
19		*Lepadella oblonga*

Appendix 8 Habitat Management

Catchment Management and Dam/ Dambo Management Guidelines

General Integrated Catchment Management Guidelines

A Catchment means a geographical area which naturally drains into a water resource and from which the water resource receives surface or ground flow that originates from rainfall[33]. During the ESMP and BMP assessments for the rehabilitation sub-project, concerns were expressed about the management of the upper catchment of the stream, which should be handled by stakeholders in the operation phase for sustainability.

These concerns related mainly to existing land use practices and resulting erosion and siltation problems including water quality problems. The present land-use practices at the Makaba Dam sub catchment may be unsustainable due to issues related to crop farming close to the water bodies, livestock grazing, livestock watering practices, tree cutting, fuel wood collection and fires. These result in high sediment loads and nutrient enrichment of the water bodies, particularly after rainfall events, thus impacting on the water quality with the potential to undermine the long-term storage capacity of the Dam and dambos which will affect the biodiversity habitats.

To address these, and other concerns in the catchment, the Water Resources Management Authorities (WARMA) provides for catchment management and local government offices and DMC have to put in place catchment management to examine land-use practices within the dam catchment, to identify key areas to be targeted to move towards more sustainable management of the catchment, and to develop a plan that serves these ends while also identifying how local communities can benefit through the proposed activities. A draft plan that can be used by the stakeholders is presented below:

1) Policy and regulatory framework with the relevant institutions
    - Forest Act No. 4 of 2015
    - Fisheries Act of 2011
    - Water Resources Management Act (WARMA) No 21 of 2011 and Department of Water Resources Development DWRD- Reference for catchment management provisions
    - Zambia Wildlife Act of 2015
    - Water Act, 1964
    - Lands Act of 1964
    - Agriculture Lands Act No 57 of 1960; and
    - WASH legislation

According to WARMA, The Water Resources Management Act of 2011 provides for a decentralized management system in line with the principles of Integrated Water Resources Management (IWRM) that manages water resources at catchment and sub-catchment levels and promotes local participation through formation of Water User Associations (WUAs)/ DMAs. Functions of catchments and sub-catchments (enshrined in Part III section 18 & 20 of WRM Act No 21 of 2011):

- Coordinating, supervising, monitoring and evaluating Water Resources Management activities in the water catchments

[33] WARMA Act

- Disseminating Water Resources Management information, regulations and standards to the public
- Collecting, monitoring and analyzing hydrological and hydrogeological data for WARMA decision making
- Developing water allocation plans and making recommendations on water allocations for the issue of permits
- Contributing to the development of catchment management plans, sub catchment plans for water allocation decisions and other water use plans
- Promoting participatory water harvesting and water conservation initiatives

2) The vision for the integrated catchment management plan for the Ndondi Dam catchment can be derived from the key issues raised in the consultation process, which is to ensure sustainable land use practices to protect the water resources of the catchment while enhancing biodiversity, dam uses and the livelihoods of the communities in the catchment.

3) Underlying this vision, are the following aims of the plan, derived from the studies and the consultation processes:
   - To provide for the establishment of a Catchment Council/ Catchment Management Committee, which will coordinate and oversee the preparation and implementation of the plan
   - To provide a snapshot of the current status of the catchment
   - To ensure ongoing engagement with stakeholders on the priorities and implementation of the plan
   - To ensure the reduction of soil erosion and sedimentation in the catchment and to protect the water quality of the dam
   - To support the improvement of livelihoods of the communities in the catchment
   - To address other key biodiversity related issues in the catchment, as will be identified.

4) Principles that drive conceptualization and implementation of the plan.
   - Participatory management
   - Using labor intensive/ involving approaches
   - Using local resources
   - Empowering local communities, particularly women and youth
   - Sustainability

5) Catchment-wide projects will be proposed to protect the dam, or may already be in place or planned for implementation. These can include:
   - Communication and awareness
   - The establishment and functioning of the Council
   - Formulation and training of the DMC and users association
   - Community capacity building and training;
   - Provision of sanitation facilities
   - A sustainable livelihoods programme
   - A sediment management programme
   - A reservoir/ dam management plan
   - A dam sediment study
   - The establishment of new monitoring points and revision of monitoring frequency
   - Implementation of water quality monitoring variables

- Accreditation of a water laboratory
- Zoning plan for use of upper catchment
- Mapping of key wetlands
- Development of policy on management of invasive plants
- Creation of indigenous plants nursery
- Energy sources assessments
- Provision of off-channel livestock watering points
- Zoning of buffer zone around dam
- Dam and Dambo Management

6) Time lines:

It will take time and years for the activities identified in the plan to change the current land-use practices across the catchment, but there will be a good foundation of community understanding of the issues on which to build, and there are already good practices in the catchment which can be built on, developed further, and disseminated more widely.

7) Funding:

For catchment management to be sustainable in the long-term, sustainable funding beyond what is currently available through the dam rehabilitation sub-project is required to continuously support the catchment management activities. These include the sustainable funding for the functioning of the committee, which will require relatively small amounts, and funding for the implementation of catchment management activities, which will require larger amounts. Total estimated costs will be established by the stakeholders' council for instance for the first 5 years then per annum costs. There are three potential sources of funding for implementation: donor funding, funding from government budgets, and funding through introducing a system of Payment for Environmental Services (PES)/ User fees (WARMA Act). These require significant discussion and engagement between the community, policy makers, stakeholders and government representatives.

Dam/ Dambo Management

This section provides guidance on retaining, maintaining and where necessary re-establishing vegetated riparian buffers around the sensitive water resources (stream, dam / dambos) managed, and work sites (campsite, slopes, borrow areas etc.) as pointed out by the area of influence and in the BMP management plan Section 5. The following riparian zone management procedures will be implemented:

- Vegetation retention of existing undisturbed local provenance native plants should be standard practiced by the contractor and locals
- Restoration of native vegetated sites and buffers which have been degraded or removed, re-vegetation of slopes, should (where practical be restored) with native vegetation equivalent in type, form, density, and diversity to that occupying the adjacent area or more as approved by the engineer. Planted buffers should consist of a mix of native trees, shrubs and groundcover using natural and assisted vegetation as indicated in the ESMP.
- These buffers and revegetated sites should be sustainable, with the least practical need for human intervention. Management activities may periodically be necessary to remove invasive species, for hazard reduction to prevent wild-fires and ensure community safety.

- Riparian vegetation provides a natural boundary. Buffers should be measured outward from any recognized damp land vegetation fringing the water resource or where the margins of missing riparian vegetation are uncertain, and the rain season banks of the water body.
- Buffer composition should comprise under-storey vegetation (grasses), over-storey (tall shrubs, trees) and carbon-rich tree parts on the ground matching the density and diversity of undisturbed local native vegetation.
- Wildfires control measures must be in place to protect riparian buffer zones.
- Unpaved roads pose a risk to water bodies due to stormwater causing surface erosion and associated water channeling which increases the rate of contaminated water movement. These must not be close to the dam or dambos. There will be a buffer between the busy roads and the water bodies.
- Maintaining some grass at the water inlets to beneficial for sediment and contaminant filtration purposes.
- Contamination prevention is important with land use activities set up and operated to have minimal impact on buffers and associated water resources. Precautionary strategies to protect buffers from harm, erosion may include:

a. restricting land disturbance activities to the low rainfall seasons;
b. managing stock numbers, feeding, watering and location to lower risks areas;
c. isolating potentially harmful materials from water;
d. immediate and effective waste spill clean-up;
e. use of structural stormwater retention/ drainage systems/ slopes;
f. implementation and sensitization of environmental management plans; and
g. training of staff, locals and contractor in good operational practice.